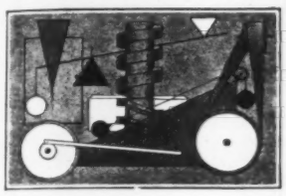
MACHINE DESIGN

as it affects

ENGINEERING–PRODUCTION–SALES

Volume 4 | June, 1932 | Number 6



Forthcoming ISSUES

MACHINES are traditionally noisy. Even though efficiency of workers increases as amount of noise decreases, this fact has been regarded apathetically, with most effort devoted to deadening the noise instead of eliminating its source.

Now, however, engineers are seeking to reduce noise to a minimum. On page 13 of this issue begins the first article of a series on this problem which will be extended in future issues to include characteristics of noise, how designers may take advantage of these characteristics, and practical solutions.

L. E. Jermy

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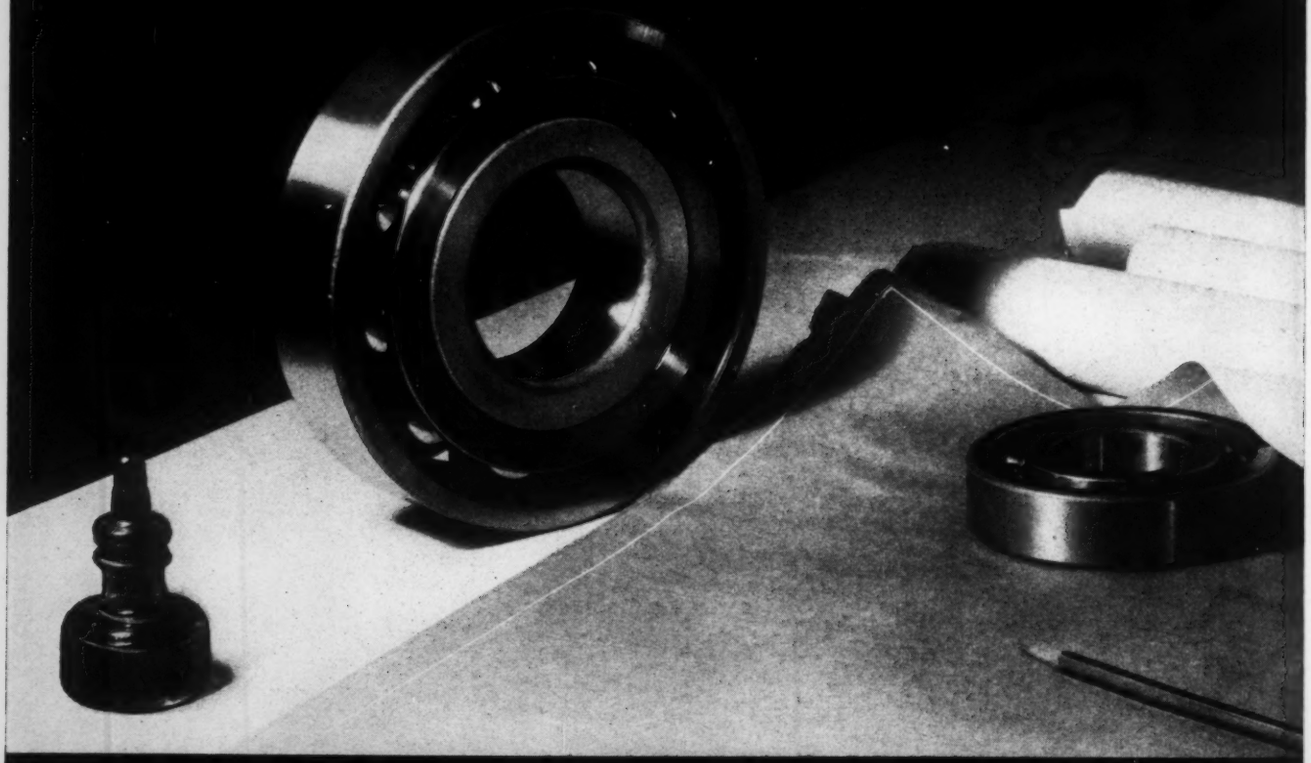

NEW DEPARTURE BALL BEARINGS

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DURING the past few weeks several readers have written asking us if reproductions of the illustrations "Great Moments in Machine Design" were still available. Fortunately for those interested, we have a few sets left. You will very likely recall that these reproductions included such famous subjects as "James Watt and His Steam Engine," "Patrick Bell and The Reaper," "The Wright Brothers and Their Airplane," etc. The complete set of sixteen is available for one dollar.

What is the RECONSTRUCTION *Finance Corporation* Doing?

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WHAT ARE THE CHANGES IN THE ECONOMIC PICTURE?

THROUGH the Reconstruction Finance Corporation, the enlarged powers of the Federal Reserve System, the campaign against hoarding, and the United Action for Employment, great fundamental changes have developed.

Beginning in the summer of 1931 with the financial crisis in Germany, followed by the suspension of gold payments in England, a tremor of fear went through the entire world. The shock manifested itself in America by enormous gold withdrawals on the part of foreign central banks which had been leaving their money on deposit with us for years. Bank failures increased rapidly in this country as a result of the financial excitement, which encouraged the hoarding of currency and the sale of securities.

This picture is now changed. Money is being returned to circulation. The resources of banks that failed in March are about equalled by the resources of the banks that reopened. People are becoming impatient with anything which is obstructing the return to normal trade and normal living. The dollar is able to buy more in merchandise, services and securities than it has for many years. The *active dollar* is the only dollar that is valuable, and it is now putting its more slothful neighbor to shame.

"As the most nearly self-contained nation, we have within our own boundaries the elemental factors for recovery."

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MACHINE DESIGN

THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO

June, 1932 Vol. 4—No. 6

Noise and Machines—Must They Be Synonymous?

By Hiram Percy Maxim

UP to recent times designers of machinery have not concerned themselves seriously about noise. Times are changing, however, and noise is becoming an important factor. Designers should know more about this disturbing element and what governs its control, with a view to the development of more efficient and salable units.

One of the basic facts to bear in mind in considering noise in design is that audio vibrations will flow along a circuit made up of mass or stiffness, just as electricity will flow along a circuit that is metallic. Another fact is that vibrations which are sufficiently infrequent, or low in number per second, will not radiate into the surrounding air, at least to a degree that is offensive to the human ear. Still another fact is that the human ear will "hear" a frequency that may not be present. The mechanics of the ear are such that the fundamental frequency may be created from its harmonics. When this occurs, treatment for attenuating the fundamental may be of no avail. In such a case, we treat for the harmonics in order to get rid of the frequency we think we hear.

The human ear does not detect the true relative intensities of two sounds. Intensity as indicated by the ear increases by simple arithmetic progression. As indicated by a microphone and recording apparatus, it increases by logarithmic progression. This has caused a new unit called the decibel to be introduced.

If we were to define roughly a decibel, we would say it is the smallest change in loudness that the average ear can detect. A more exact definition would be, the ratio of intensities of two sounds. For example, if the electrically measured intensities of two sounds are in the

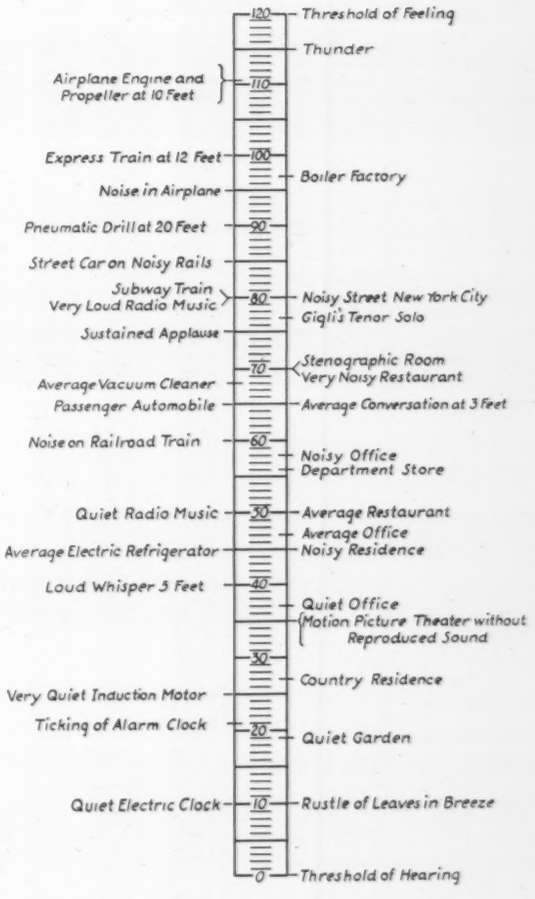

Fig. 1—Loudness chart showing comparative values of noise measured in decibels, compiled by Harvey Fletcher, R. S. Tucker, W. Waterfall A. H. Davis and R. H. Galt

ratio ten to one, they differ by ten decibels. If the ratio is one hundred to one, they differ by twenty decibels. If one thousand to one, thirty decibels, and so on.

A rough idea may be gained by considering that the difference between the threshhold of audibility and the sound of average conversation as heard at a distance of one yard is a little over sixty decibels, Fig. 1. When a loudness has gone up from 10 to 100 decibels, or ten times, the intensity or actual energy represented has gone up from 10 to 10,000,000,000 or a billion times. This accounts for the surprising amount of improvement that the engineer must effect before he attains what is considered a worth while reduction in noise.

The automobile is a splendid example of control of machine noise. In the early days of sliding gear transmission, the drive was through gears on all speeds and all were noisy. Then we conceived the idea of direct drive on "high" gear because it was used most of the time. "Second" and "low" were left noisy. We ran along thus for several years.

WITH introduction of the decibel and machines for measuring noise the problem of combating this factor in design has been stabilized on a scientific basis. MACHINE DESIGN has published numerous discussions on the subject in past issues, and the accompanying article constitutes the first of a series supplementing these. It is fitting that it be prepared by an authority who has devoted twenty years to noise problems, the president of Maxim Silencer Co., Hartford, Conn.

But noise continued to be troublesome. We improved our engines, we had recourse to spiral and herringbone gears and chains in our camshaft drives. We reduced valve tappet clearances to avoid clattering, we developed elaborate balancing systems in our crankshafts, we improved bearing and piston fits in order to take out knocking noises, and a multitude of other things.

However, this did not entirely meet the demand for less noise. This year's models had to have something radically better. The designers of these cars made use of the theory of insulation. In these cars, the engine with its change gear unit is mounted in rubber upon the chassis in such manner that no high frequency oscillations in the former can reach the latter. No other noise-governing change, other than the prevention of forced oscillations reaching a good radiating surface, the body of the car, was made, yet the latest cars are tremendously more quiet than anything ever before attained.

In transplanting the noise reducing principles learned in motor car design to stationary practice, we may take the gear reduction in a small steam turbine as a good example.

The noise in a turbine gear reduction is created by the lack of smoothness in the shifting of the load from gear tooth to gear tooth. The number of loadings and unloadings that occur per second is enough to create a frequency that can make an extremely offensive sound. If the teeth were absolutely accurate this shifting of the load would be smooth, and if smoothness were attained, we should have quietness. But it is not yet practical to get perfect gear teeth.

Intermediate Structure Deadens Sound

Were we to make use of the exact principles used in the latest motor car engineering, we would have to insulate the general structure from the structure that is exposed to the air. In the motor car, there is an intermediate structure, in the form of a bonnet or housing, between listeners and the vibrating engine and gear box. There is no such intermediary in the ordinary small turbine. There is nothing to stop oscillations from traveling through the body of the turbine pinion and gear into their respective shafts, across the oil film in the bearings, into the bearings, and through the bearings into the frame and main housing. From the housing they radiate into the air.

Treating the housing as though it were a bell and laminating to deaden it, is a solution. In theory this appears fine, but in practice it is found that once the vibrations are allowed to spread into the general structure they leak into everything else in the machine, and make laminating too much of a job. It rarely is possible to laminate the outside housing, and it is better to catch the oscillations while they are small and before they have an opportunity to spread.

There is still another noise trouble which

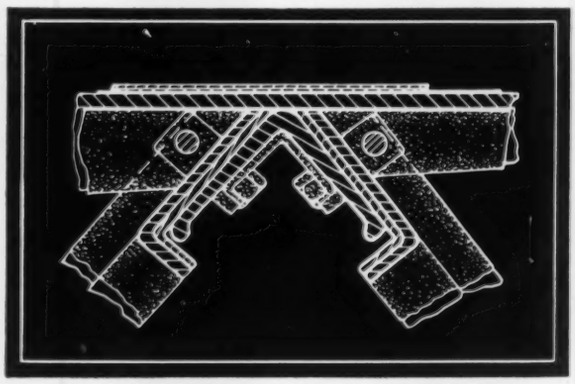

Fig. 2—Prevention of transmission of noise and vibration between structural parts in an airplane is accomplished by giving each piece a resilient rubber coating and also by coating the finished assembly

arises in gear boxes and turbines. It is the noise that passes through the walls of a machine but which is not generated in a mechanism. Examples are steam clicks in radiators, loud hissing noises such as come from pressure reducing valves, the whine from turbines and the familiar knock that occurs in motor car engines when the carbon needs removal.

It is evident these noises must be of high frequency in order to effect a quick enough rise in pressure to simulate a hammer blow. This condition is approached in a high speed gear reduction. In spite of the oil present, the frequencies set up by the meshing of the gear teeth are so high that they radiate into the air space inside the housing, are transmitted through the wall housing and thus to the ear. This class of noise is difficult to handle. At this time careful laminating on the inside is favored.

An expedient that is tried often in an effort to reduce noise is spring mounting. In the majority of cases where it is used, it is evident that the designer did not thoroughly understand the action of springs. A spring is introduced in order to secure insulation. There is no hope of its acting as a dissipator as rubbing laminations act. In order to be able to act as an insulator, it must be able to absorb and return the oscillation. In order to absorb and return, it must have low enough mass to yield as quickly as the frequency characteristic of the vibration demands. Since we are contemplating audio frequencies, we are talking about anything from 100 per second to 2500 or more per second. Were we considering mechanical vibration, such as a revolving mechanism turning at 1800 revolutions per minute, we would be talking about frequencies of only 30 per second, which is a different thing as far as spring mounting is concerned.

Sensitive Springs Required

In any spring mounting which must insulate against audio frequencies, the springs would have to be extremely light and sensitive. This is the difficulty with spring mounting for high frequencies and it is of importance that machine designers realize it.

Another matter that is frequently misunderstood is the "diaphragm effect" of flat surfaces, or as some term it, "sounding board effect". It is coming to be more and more conventional to build up frames and housings from welded steel. This introduces more unbroken flat surfaces, or plain surfaces, than has been the case in the past. It therefore becomes necessary where noise is considered to understand the accoustics of flat surfaces.

This matter should be divided into two parts.

1. Where gas pressures are involved.
2. Where mechanical noise vibrations are involved.

THE machine age, in addition to major sociological and economic changes, is characterized by an amount of noise new in human experience. A sensitive person viewing our civilization might be led to conclude that there exists a squalor of noises in a world of mechanical splendors. Because of these noises, such typical branches of engineering as civil, mechanical and communication have had to turn their thoughts to a new field which may be called noise engineering.

"Since noise in modern life is, in one sense, largely due to the engineer, it seems fitting that the engineer should now concern himself with ameliorating existing conditions."—Sidney K. Wolf, director of acoustic consulting service, Electrical Research Products Inc., New York, in an address before American Philosophical society in Philadelphia.

In the case of 1, gas pressure, it usually is pure diaphragm effect. Any audio frequency vibrations that exist in the gas will cause a surface to vibrate in true diaphragm fashion. The problem is to discourage the flat surface from vibrating like a diaphragm. This can be done by stiffening the surface by means of ribs or by laminating the surface so as to secure rubbing effect.

In the case of 2, mechanical noise vibrations transmitted to the metal surface through the structure of the machine, we have general forced oscillations to contend with rather than pressure oscillations producing diaphragm effect. The entire structure of the machine is vibrating. In order to damp out these forced oscillations or vibrations, there is but one good way to proceed and that is to insulate the surface so that it will not receive the oscillations from the rest of the machine. Where we cannot insulate, the next best thing is to laminate and secure what damping effect we can.

There are countless examples of noisy machinery which cannot possibly be covered in a short article. In cases where a noise is emitted from a pipe, such as the exhaust or intake of an engine, or the intake of an air compressor, or any kind of a machine having a discharge and a suction, it is possible to silence the noise by applying an appropriate silencer. Where the noise cannot be eliminated at the point of origin, the only alternative is to enclose the noisy machine completely.

In closing the writer would like to stress the extreme desirability of engineers and designers providing for noise control when the design of a machine is being laid down. More money, trouble and time will be saved in the completed equipment than is believable.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

Device Sets Type Automatically

PROGRESS is measured largely by the creation of new ideas, the keystone of industry. Following their conception new developments flourish and now, probably more than ever before, the various branches of industry are characterized by noteworthy innovations. The printing and publishing field is one which offers three examples of outstanding achievement: Henry A. Wise Wood has perfected a four-color newspaper press for the *Chicago Tribune;* Buford L. Green of the *Charlotte, N. C., Observer* recently announced the completion of a device which works in conjunction with a typesetting machine to set type directly from copy, eliminating the keyboard; and a photoelectric engraver to make newspaper halftones without acids has been invented.

The Semagraph, this being the name by which the typesetting attachment is known, utilizes a vacuum tube. To meet the specialized requirements of the unit, Mr. Green also devised a motor-driven typewriter which writes a code simultaneously with the usual letters and characters. This code is made up of dots arranged in various positions to effect the selection of the specified matrices or linotype letter molds.

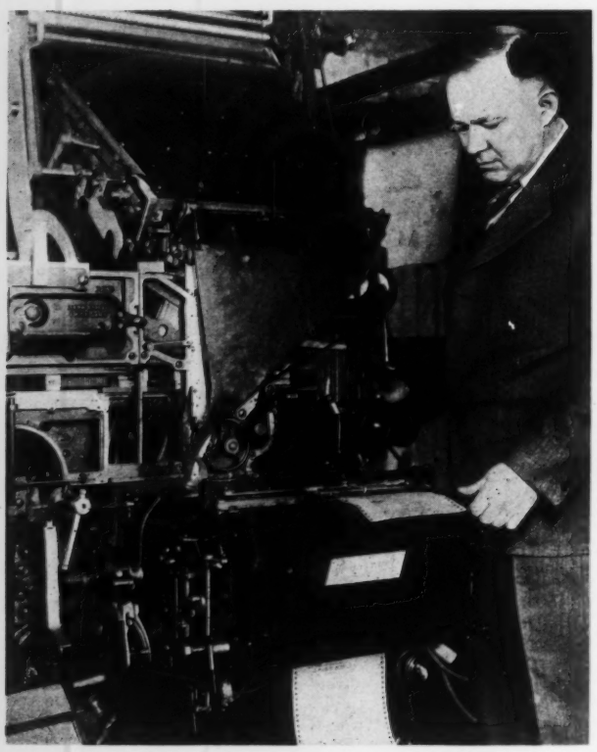

Fig. 1—Photoelectric cell is employed in this device to set type directly from copy

Copy is fed through the Semagraph, Fig. 1, and the electric eye reads it. The photoelectric cell is mounted within the case, immediately beneath the copy, while the light source is located in a housing a few inches above. Checking and admission of light governed by the dots control the selective process.

As shown in the illustration, the new unit is installed in the position occupied by the conventional keyboard, the 90 or so cams of which are eliminated by the Semagraph. The keyboard of the special typewriter carries 41 keys for characters and space signals, the usual space bar printing the signal which drops the space bands of the typesetting machine. Paper used is perforated on both edges like a motion picture film, these perforations being needed to register the copy as it passes through the Semagraph. Movement of the copy is entirely automatic and the machine stops when the copy is exhausted.

Mountings Reduce Shock, Vibration

MOUNTINGS, whether employed in automotive or industrial machinery design, command vital engineering interest, particularly because of the increased attention being devoted to design details which obviate transference of objectionable forces and promote mechanical refinement. It has been found that shock and vibration may be combated by studied mounting methods, and in the case of the new Ford a more effective body, spring and chassis design has been achieved by giving specific consideration to a new idea in rear spring suspension, Fig. 3.

By placing the rear spring behind instead of

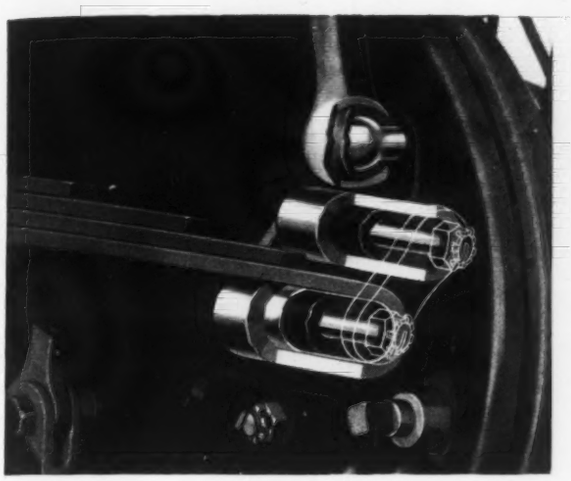

Fig. 2—Rubber insulators on the new Ford eliminate wear and the necessity of lubrication

directly over the axle, an increase in the length of the frame was possible, lower body effected, and the hump which previously existed in the middle of the rear spring eliminated. Ends of the rear spring are attached to brackets extending to the rear of the axle tubes. The spring is curved in a horizontal as well as in a vertical plane to clear the center of the differential housing. The lower spring suspension not only adds to the riding comfort of the car but it also contributes greater safety because of the lower center of gravity of the body.

Of unusual design also is the single point rear mounting of the Ford engine. It consists of a steel plate with a center opening, having a rubber ring vulcanized to the plate around the opening. The plate is bolted to the front of the center cross member of the frame. The rear end of the transmission, and the front end of the torque tube or universal joint housing, are bolted together through the plate and rubber ring; thus rubber in compression is interposed between the engine, the torque tube, and the chassis frame.

Model B (4-cylinder) is equipped with a vibration damper of the friction type, consisting of an arm with a pair of disks which fit on either side of a plate secured to the dash above the engine. The free end of the disk arm is attached to the rear of the engine, and pads of rubber impregnated felt ½-inch thick are used between the disks and the plate.

Another outstanding feature of the new Ford is the extensive use of rubber. Insulators of this material are used in all spring shackles, Fig. 2, in the shock absorber links, the ball socket of the front radius rod and as stated above, in the engine mounting. The rubber insulators in the spring shackles withstood a test of more than a million full 4-inch strokes on the spring. Employment of this material over metallic bushings eliminates wear and lubrication of these points.

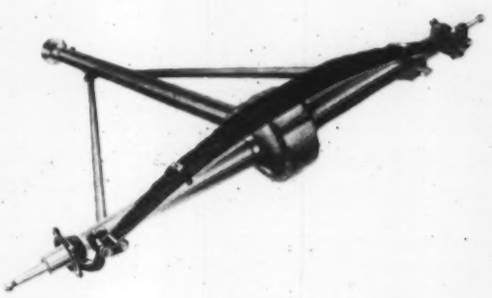

Fig. 3—Distinct advantage in design is achieved by placing the rear spring behind the axle

Synthetic Materials Replace Metal

SELDOM a month passes without numerous innovations in the use of materials, metallic and nonmetallic, in one or another type machine. Selection has become as important as the mechanical layout of the unit, in fact success in market acceptance now depends largely on a wise choice of materials.

Synthetic plastics are replacing the more obvious and older materials as evidenced by a control wheel, molded by Norton Laboratories, Lockport, N. Y., from Durez. The unit is formed in one operation, and is characterized by lightness, resistance to corrosion, a desirable surface, and cost economy. The only finishing operation necessary is the removal of a slight fin or flash formed where the mold joins.

Fig. 4 — Molded bakelite was used in this unique manicuring machine which eliminates the conventional hand operation and occupies only nine square inches of table space

In a new electric manicuring machine, Fig 4, which eliminates the conventional hand method and speeds up the operation, John D. Stuart, South Euclid, O., the designer, has employed bakelite molded material for the greater portion of the body of the unit. The new device is neat and compact, requiring only 9 square inches of table space. The round dome when given half a turn comes off, affording easy access to the motor.

Other recent applications of bakelite include

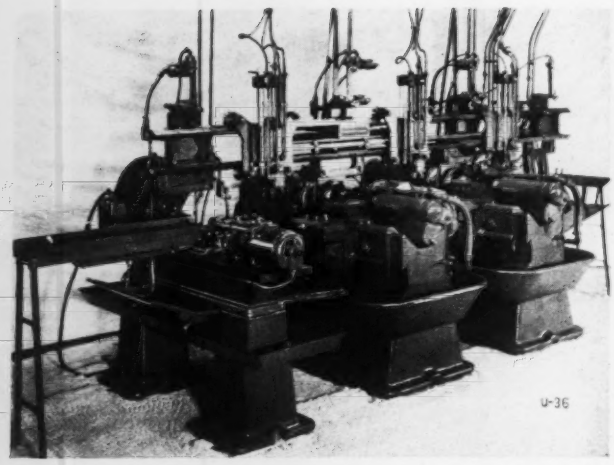

Fig. 5—Standard machines are employed in a continuous production unit incorporating automatic loading

the use of a laminated bed plate to eliminate suction on the "ditto" machine. This condition which prevailed between the bed plate of the duplicator and the sheets of paper, was a source of annoyance and trouble. The bed plate employed to solve the problem has a symmetrical pattern of depressions over its entire surface.

Standard Machines Combined As Unit

AUTOMATIC loading of machines is the natural result of progress in designing units to expedite production schedules. Utilizing standard machines, Seneca Falls Machine Co., Seneca Falls, N. Y., has developed a loading device to be employed in connection with them, as shown in Fig. 5. One attendant supervises their operation.

In this particular case rough forgings are placed on the conveyor, shown at the left, which carries the work to the centering machine. The centered forging then is picked up by fingers and carried to the rough turning machine where it is placed between centers ready for processing. Simultaneous with this operation another set of fingers picks up the forging which has been rough turned and places it in the finish turning machine, as still another set of fingers carries the finished turned piece and delivers it to a chute.

Various movements of the loading mechanism are obtained hydraulically, there being a cylinder and piston for providing longitudinal or transverse movement and cylinders for raising and lowering the gripper fingers. Tailstock spindles also are operated hydraulically. Electric switches actuate solenoid valves, and the control is so arranged that the completion of one movement starts the next. The closing of the fingers on the work makes a contact which actuates the tailstock spindle, withdrawing the center from the work. When the center has receded a proper distance it makes a contact which causes the gripper heads to raise.

This arrangement reflects the ability of designers to utilize hydraulics, solenoids, standard machines and the idea of straight line production in the development of equipment to meet modern requirements. The trend is definitely in the direction indicated by this newly patented machine.

Adopts Vacuum Cleaner Idea

DUST-ridden atmospheres in most cases are not beyond the control of the designer. If this condition persists as a result of machine operation, indications are that the equipment lacks refinement. With dust collector devices long an institution in common household appliances it followed that this idea could be adopted for arresting fine abrasive materials released in sanding and grinding operations. The design engineer may be held responsible for the contaminated air breathed by the operator with possible injury to his respiratory organs, and for this if for no other reason, it behooves the technician to utilize combative measures.

Originators of a hand belt sander, the Porter-Cable-Hutchinson Corp., Syracuse, N. Y., recently introduced the first of this type unit equipped with a dust removal system. Details of the portable machine shown in Fig. 6, disclose that compactness also was considered as one of the essentials. A six-bladed fan traveling at 10,000 revolutions per minute creates a powerful vacuum which draws the dust through two ports behind the rear drive pulley into the bag. This dust is deposited in a beater (inside bag) which can be removed easily through a zipper opening.

Not only does the vacuum system remove dust but it also prevents excessive clogging of abrasive with the result that the grit on the belt remains sharper, facilitating faster cutting and longer belt life. The motor is of the universal type (MACHINE DESIGN, March, page 30).

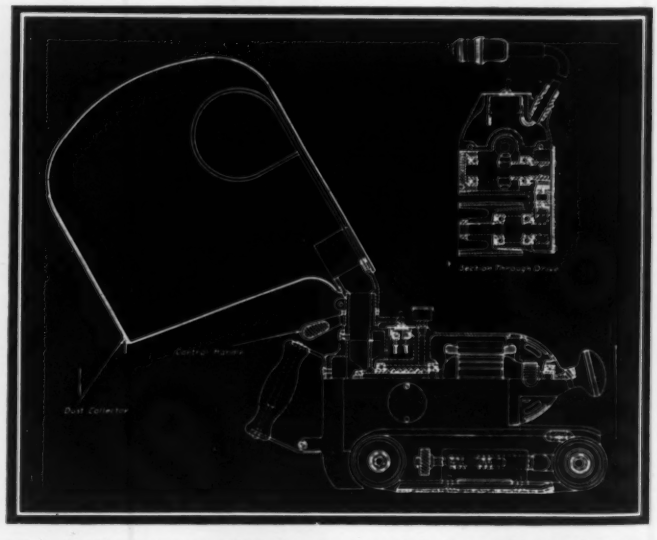

Fig. 6—Vacuum created by a powerful fan collects dust resulting from the operation of this sander

Insuring Compactness by Building In Control Equipment

Fig. 1—Enclosed type construction permits mounting controls in machine base

THOUGH the designing engineer may produce new and unique apparatus, unless he creates machines which can be sold his efforts are of little value. It is for this reason that in considering the application of machine parts in the design of new machinery consideration also should be given to sales trends in industry. This is particularly the case in connection with electrical control apparatus, many changes having taken place in recent years in the design, application and purchase of this type of equipment.

Drawing a simile from other lines of industry, it is not long since the radio business was a parts business, but as this field has progressed, the set manufacturer has provided more and more of the essential unit until, at the present time, very few people would consider seriously buying a radio set which was not complete and arranged for operation from a lamp socket. Some years ago the automobile industry also went through a similar process.

It has become almost axiomatic that the less attention an article requires, both on first installation and in maintenance, the wider its market becomes. Although equipment still is sold to business establishments that does not fall exactly into the same classification, there is an increase in tendency in this direction. Manufacturers of many types of machinery such as machine tools, printing presses, dough mixers, etc. have found it to their advantage to supply not only their machines, but the complete electrical equipment to operate it.

Numerous reasons for this trend are apparent. The manufacturer of a machine is interested in seeing that his equipment gives a maximum of service to his customer. If it does, he not only has the satisfaction of a job well done but also is in line for obtaining further orders. The manufacturer also is usually in an excellent position to choose the electrical apparatus to operate his machine. He knows the characteristics of the machine, and from his experience in the development of earlier models naturally should be able to make the best selection of the motor and control apparatus. In many in-

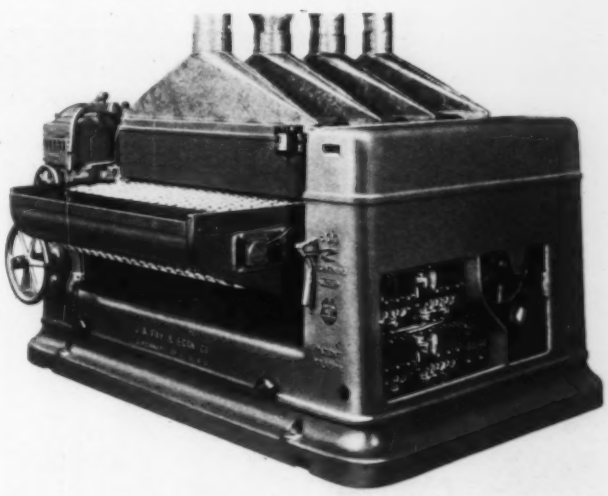

Fig. 2—Motors, control equipment and push button stations built integral with structure of machine

stances, and especially in the case of machines purchased in large quantities, the manufacturer of a machine undoubtedly can buy and assemble electrical apparatus at a lower cost than that at which the individual customer could purchase all these items separately. There obviously is considerable advantage to the user, too, in the placing of one order for equipment instead of the placing of a number, the apparatus manufacturer being able to keep down his production costs in the handling of quantity orders.

Previous Experience Assists Manufacturer

Machinery builders furthermore are in an advantageous position in regard to the mounting of electrical apparatus because they, having in mind the manufacture of many similar units, can afford to spend more time in studying the question of mounting the electrical equipment and therefore in general will produce machinery of better appearance. They also will naturally mount the equipment so that it will be easier to maintain, realizing that if the machine is not satisfactory in this respect it is likely to go entirely unserviced until necessity compels attention.

Electrical apparatus should be so placed that the service wires can be run easily and economically. The majority of machine builders who supply electrical equipment purchase the standard enclosed control apparatus and mount it on their machines. Others find that a more desirable result can be obtained by mounting the control apparatus inside the machine, as instanced in some of the accompanying illustrations. In other cases, due to the size of the electrical apparatus necessary, or for other reasons, the control equipment is supplied but furnished for separate mounting.

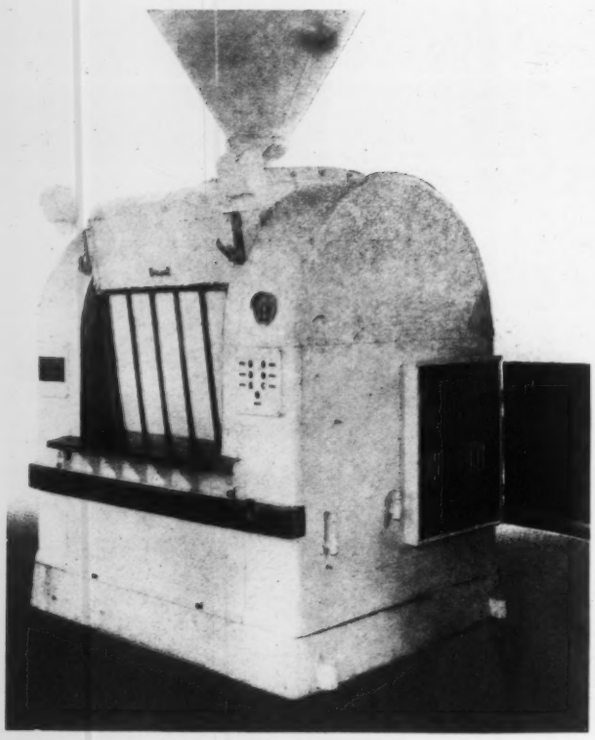

Fig. 3—Seven push buttons are included in the one panel at right of this dough mixer

Control apparatus frequently is mounted inside the machine where the mounting space can be provided without increasing the cost of the complete assembly. When controls are built in in this way, conditions should be checked to insure that excessive temperatures are not created. This is particularly true in those cases where a resister is used for starting or speed regulating. On a number of machines where the functions to be performed are complicated, the controller sometimes is large compared with the size of the machine and in such cases it usually is necessary to mount the control apparatus separately.

In cases where there is severe vibration, care should be taken in the selection of control equipment and if vibration is excessive, it again may be desirable to mount this equipment separately. Where control accessories are supplied, such as push buttons, limit switches, etc., it often is preferable for the manufacturer to mount them, as he is more familiar with the requirements for the reasons mentioned in the foregoing and can do the job more economically than the customer. Another factor which should not be lost sight of in the application of control equipment is the selection of apparatus which generally is acceptable in the industry being served.

Controls Are Incorporated in Base

Reference has been made to the matter of appearance in building control equipment into the body of the machine. An excellent instance of a pleasing effect being realized by following this procedure is shown in Fig. 1. In this case the Fay & Egan company, manufacturers of the molding machine illustrated, followed closely the trend toward the box type of construction in developing its machine, and working in conjunction with Cutler-Hammer engineers was able to incorporate all of the electrical control necessary in the base of the unit as an integral part.

This control includes open type switches for overload and undervoltage protection and is so arranged that if any one of the motors shuts down due to overload, all of the motors would immediately be disconnected from the line. The push button station, also built in, unfortunately does not show in this illustration, being on the far side of the machine; the somewhat unique method of mounting the motors is evident, however, and taking all of the factors mentioned into consideration, the machine is particularly outstanding as an example of progressive design.

In the case of another machine built by the same manufacturer, the three-drum sanding machine shown in Fig. 2, more difficulty was ex-

perienced in building in the control due to the limited space available in the machine base. It can be seen that part of this space is taken by one of the motors and a drive partitioned off from the control apparatus, resulting in a neat and compact arrangement.

Built in control is especially adaptable to the requirements of equipment such as baking machinery from the angle of clean cut appearance and for sanitary reasons. In Fig. 3 is shown a Baker-Perkins dough mixer which embodies particularly interesting control equipment for controlling the main mixer motor and also the motor for operating the mixer door seen at the front of the illustration. Reversing contactors are used for the latter motor, and limit switches are provided which automatically stop the door in either the fully open or fully closed position. There also is a door interlock switch operated by a cam on the door which opens the circuit immediately the door starts to open thus preventing operation of the main mixer motor except for inching purposes which will be described later. Three push buttons are used to control the door motor, one for the opening direction, another for the closing and the third for stopping. These push buttons are mounted in a group, as seen at the right of the illustration, with the push buttons which are used to control the main mixer motor.

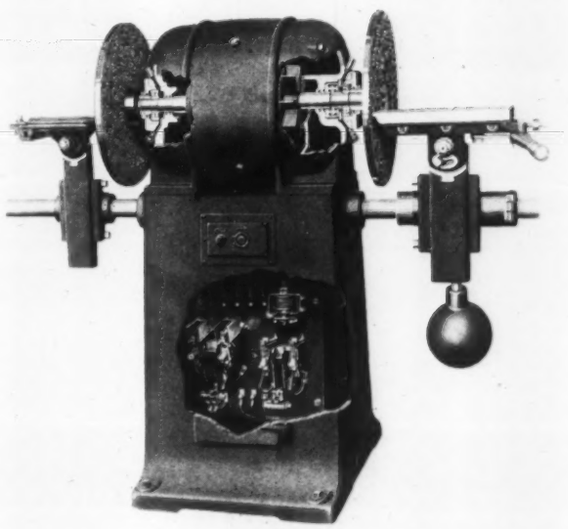

Fig. 4—Economy of floor space and neatness of appearance feature design of unit shown

The mixer motor is a 2-speed, constant torque motor of the reconnected type rated at 40 horsepower at 1200 revolutions per minute and 20 horsepower at 600 revolutions per minute, 220 volt, 3-phase, 60 cycles. The control equipment is so arranged that the motor first must be operated at low speed before it can be run at high speed. There is a timer which times out immediately after the motor has been started at slow speed and at the end of a few seconds, usually five or six, making a contact which allows the operator to transfer from low to high speed.

In order to start the motor it is necessary first to press the "Slow" speed button, which causes a contactor coil to be energized, this contactor connecting the motor windings to the line. A maintaining contact on the low speed contactor permits the motor to continue running at low speed after the operator has removed his fingers from the "Slow" button. Assuming that the timer operated by the low speed contactor has timed out and has made its contact, pressing the "Fast" button will now cause a sequence relay to function. This relay maintains itself and at the same time causes two high speed contactors to be energized, and de-energizes the low speed contactor, thus transferring the motor connections from low to high speed. The motor therefore can be run at low speed or high speed as long as desirable. Stopping the motor is obtained by pushing the "Off" button.

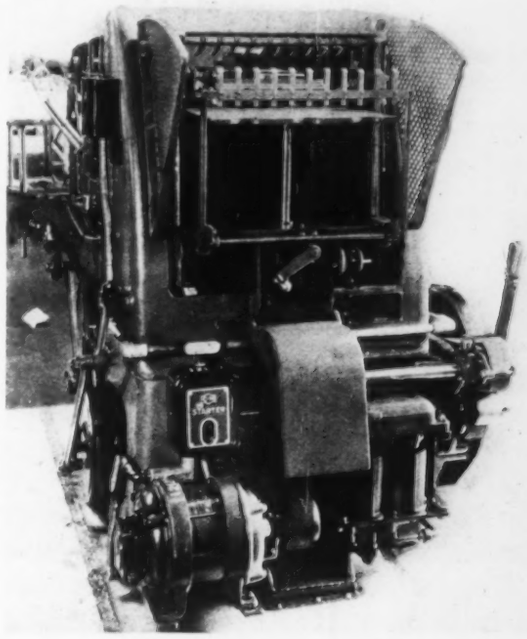

Fig. 5—Standard controls can be utilized to best advantage if given early consideration by designer

Interlock Switch Opens Circuit

Assuming that the mix has been completed and it is time to get the dough out of the mixer, the door is opened by pressing the "Down" button and stops automatically in the fully open position. As the door opens, the door interlock switch opens circuit and it is not possible to operate the mixer motor unless this door interlock switch is by-passed. A button marked "Safety" is provided for this purpose. Holding down this

"Safety" button and pressing the "Slow" button will cause the mixer motor to start at slow speed. If the mix is of the proper consistency the agitator blades will throw the dough out through the door. Sometimes it is necessary to go to high speed before it is possible to eject the dough and this is obtained by pressing the "Fast" button after the timer on the low speed contactor has timed out and made its contact, holding down the "Safety" button all the while. As soon as the dough is out of the mixer, the mixer motor is stopped by removing the finger from the "Safety" button.

The control equipment provides for connecting the motor directly to the line at low speed and for accelerating the motor to high speed through a primary accelerating resister. The

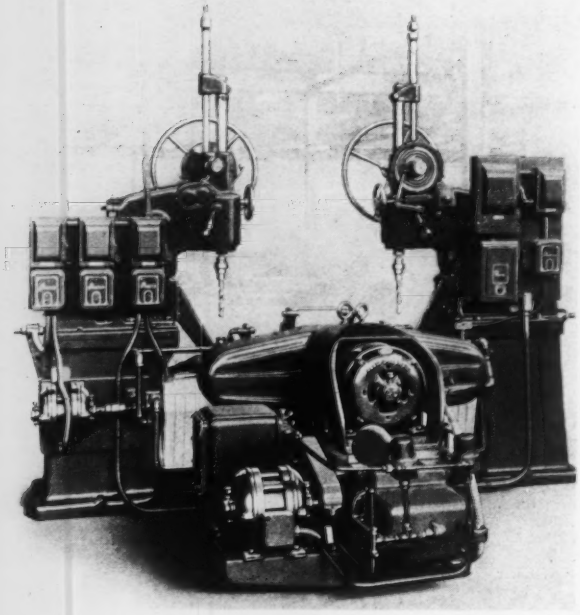

Fig. 6—Production drill embodies five motors with standard controls mounted on back of machine

accelerating resister and accelerating contactor are mounted in the base of the machine and do not show in the illustration. Thermal overload protection is provided for both the low and high speed connections of the mixer motor and the door motor circuits are provided with fuses.

A control of more simple character, but again indicative of the compactness obtainable in cases where the space in the base of the machine lends itself to accommodation of electrical equipment, is depicted in Fig. 4. This illustration shows a Gardner double disk grinder with an automatic controller and push button completely enclosed in the pedestal. The controller is a primary resister type starter for a standard squirrel cage motor, the resister limiting the current inrush to the motor. As the latter accelerates the current falls and the series relay causes the accelerating contactor to close and short circuit the resistance. When the motor to be used is of the type requiring low inrush current when connected to the power lines, across-the-line type starters are provided.

In most instances it is desirable for machinery manufacturers to complete their units without assembling all of the electrical equipment until the current specifications are known. Such a condition applies to the Miehle vertical press shown in Fig. 5, incorporating a controller case with the push button station mounted on pads on the machine frame. The wiring and conduit from the station to the controller are completed while the press is under test but the machines are stocked without the controller. The case is designed to take an alternating or direct current controller, this being assembled and connected to the leads in the case at the time of shipment.

A good example of the possibilities of mounting standard apparatus on a machine is depicted in Fig. 6. The installation on this Barnes 20-inch production drill is simple, convenient and so arranged that extremely efficient operation of the unit is possible.

Five Motors Are Employed

Across-the-line automatic starters with thermal overload protection are mounted on the vertical spindle heads and incoming lines brought in from above for each head. At the left of the illustration of the back of the machine is shown the one horsepower oil pump or lubricant motor and in the lower center a three horsepower oil gear motor. Above this and slightly to the right is a 7½ horsepower motor for the five horizontal spindles. Each vertical spindle and feed is driven by a separate motor on the front of the vertical spindle heads.

The oil gear provides an hydraulic feed for the horizontal spindles, controllers on the oil gear motor and the horizontal spindle motor being interlocked with each other and controlled from a single push button station. Each of the other controllers is operated by individual push buttons, all stations for these being mounted on the front of the machine.

The many difficulties confronting the designer of new machinery in the utilization of special and standard control apparatus as discussed in the foregoing can be overcome much more readily by consultation with the manufacturers of the electrical equipment. Too often, however, the engineers of such companies are placed at a disadvantage in recommending the best possible setup due to their being called in when the design is practically completed. By requesting the aid of the representatives of well-established companies at an early hour the engineers responsible for design not only will save himself considerable trouble but will be more assured of a satisfactory, economical and compact arrangement of this vital element in his design.

Clay Former Embodies Automatic and Multiple Features

By Otto J. Friedl
Friedl Automatic Clay Machine Co.

ONE of the oldest manufacturing processes known to man, the production of clay products, has been among the last to succumb to automatic production methods. First these products were made by hand and sun dried, then they were formed on the potter's wheel or jigger, next was created the hand press method which evolved into the single spindle power driven machine, and now there has been designed a rotary continuous automatic machine for various types of circular products as the final step in the development of the process.

This machine, Fig. 1, is of the enclosed construction type and has eight stations. It is designed so that it may be operated efficiently by the type of labor found in ceramic plants and so constructed that should any foreign objects such as small stones or pieces of iron be picked up accidentally no damage will be done. The drudgery of the old hand methods is eliminated, there is no dust as the product is trimmed wet and the removal of the flash or fin solves an old and expensive molding bugbear.

Unusual Requirements Introduced

The working of clay introduces many unusual requirements that must be overcome by the designer. Clay is a plastic substance that is prone to adhere to anything it touches, as anyone that has walked through a wet bed of it can testify. Therefore it was necessary to bear in mind in the design of the machine that all movements be positive, definitely overcoming any tendency of the material to stick. No complicated motions or unnecessary levers or springs can be employed, no casting can have sharp corners or ledges as the waste clay must fall away readily.

The first model of the machine was conceived by a ceramic manufacturer who realized the advantages of such equipment, Louis J. Friedl, who also was experienced in machine building. Although primarily intended for the manufacture of flower pots, producing approximately 6000 an hour, its method of operation is applicable to many divisions of the ceramic manufacturing field.

Before discussing the solutions of the design problems encountered in the machine, it may be best to outline briefly the operating sequence. The first step in the production of flower pots is the preparation of the clay which is delivered from a pug mill by the extrusion process. The clay, which first is in the shape of a column or sausage, of the proper diameter, is placed in a receiving trough on a belt and moved forward with an intermittent motion so timed that the cutter will remove the amount necessary for one pot. The so-called "ball" is then picked up in a rotating table with six troughs, *A*, Fig. 5, synchronized so that each one meets one of the eight dies on the turret which is traveling continuously in the opposite direction. At the proper moment the ball is deposited in the die, *B*, Fig. 2.

Dies are mounted in sleeves of hardened and ground Meehanite iron, *C*, Fig. 2, which are actuated by a circular cam on which they bear

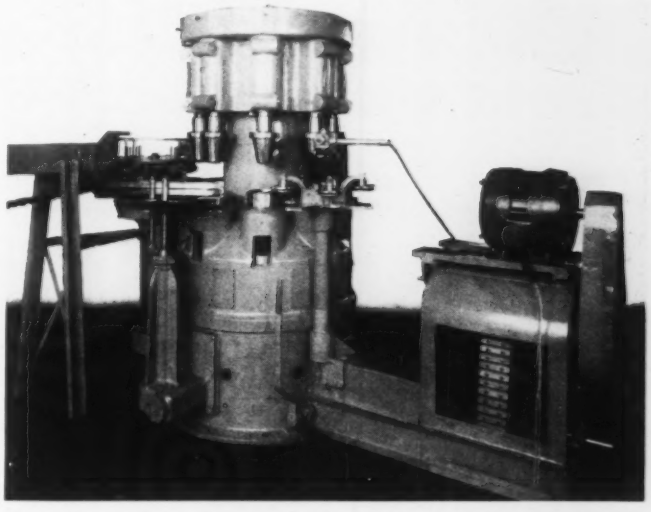

Fig. 1—Continuous automatic machine for forming flower pots which produces 6000 an hour through multiple production

through rollers. The bottom of the die *D*, is separable from the sides and the sleeves to permit raising this portion and the pots for finishing operations. As the turret, rotating on ¾-inch balls, moves around after receiving the clay ball,

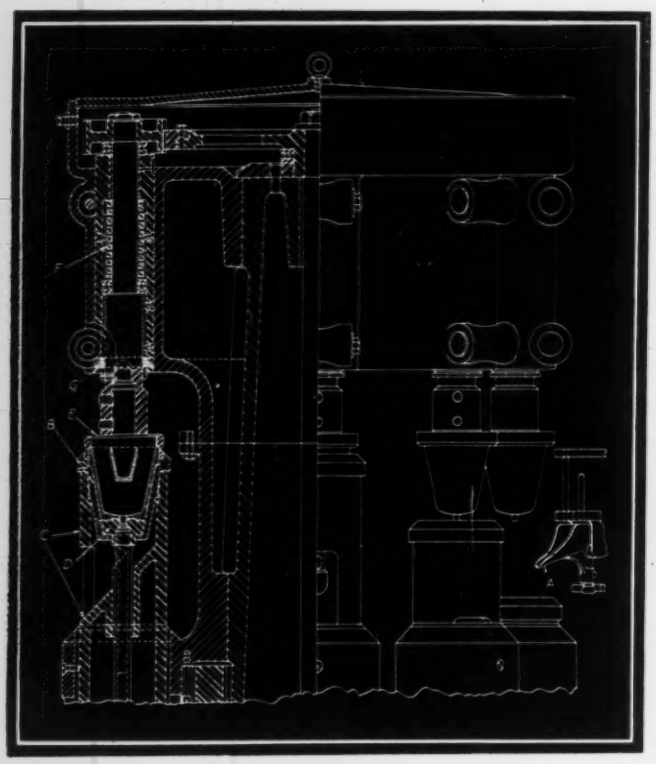

Fig. 2—Sleeves actuated by a cam carry dies up into contact with spinners which form the pot

the sleeve rises immediately and carries the die to close on the spinner or punch, the height of travel being controlled by inserts in the cam, Fig. 4, adjustable for various sizes of pots. The spinners now make the first impression on the clay. Spinners, *E*, provide a cushioning effect through spring *F*, Fig. 2, suspended in a basket arrangement. This cushioning is to compensate for the differences in hardness of the clay and to insure uniform wall thickness.

Clay Must Be Smoothed

In the making of a clay object such as a vase or flower pot by hand, the operator has to wet his fingers from time to time so that the clay will be smooth while spinning. The same principle had to be incorporated in this machine, and the spinners lubricated at a certain stage in the forming of the pot by jets of lard oil shot into the mold by compressed air. This next step in the operating sequence is made possible by the circular cam, development of which is shown in Fig. 4.

Radii on the lobes of the cam are made long to insure no rap on the sleeves at the various speeds at which the turret revolves. The first rise is at an angle of 37 degrees, selected so that the resistance to the motion would be at a minimum. At one period in the development, this angle was made steeper, but this increased the frictional resistance to such an extent that it was necessary to rebuild the cam to the original design. Within this cam there is an inner cam, the purpose of which is to elevate the bottom of the die and the formed pots, exclusive of the sleeves, for the trimming and ejecting operations.

After the spinners have made the first impression, the die recedes to allow the shot of lubricant to drop into the mold and upon the clay ball. It travels up again immediately, the mold closes, and the spinner forms a complete pot.

Flash Elimination a Problem

The final pressing operation completed, the dies separate, but they leave a flash on the pot. Removal of this flash after production on the single spindle machines, required the expenditure of much time and labor. It is insignificant while the pot is green, but becomes very troublesome after firing as it then is hard and sharp and capable of cutting the fingers of anyone handling the pots. Removal of this fin by the automatic machine was the biggest problem in its design.

To accomplish this a number of movements were experimented with, all proving complete failures. An attachment operating from the side of the machine and brought into play by a special gear arrangement, using the space between the sleeves for the drivers, shown in Fig. 1, was developed. This necessitated a specially generated gear, on top of which was mounted a revolving disk driven from a separate motor. The arrangement proved fairly satisfactory but had to be discarded because of the vibration and the fact that clay falling on the gear would throw the whole mechanism out of adjustment.

It finally was decided to trim from the top

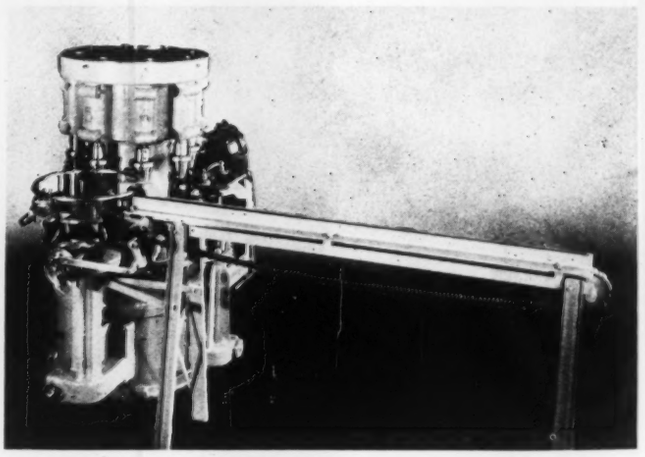

Fig. 3—Clay is placed into the dies by troughs on a circular plate loaded from a conveyor

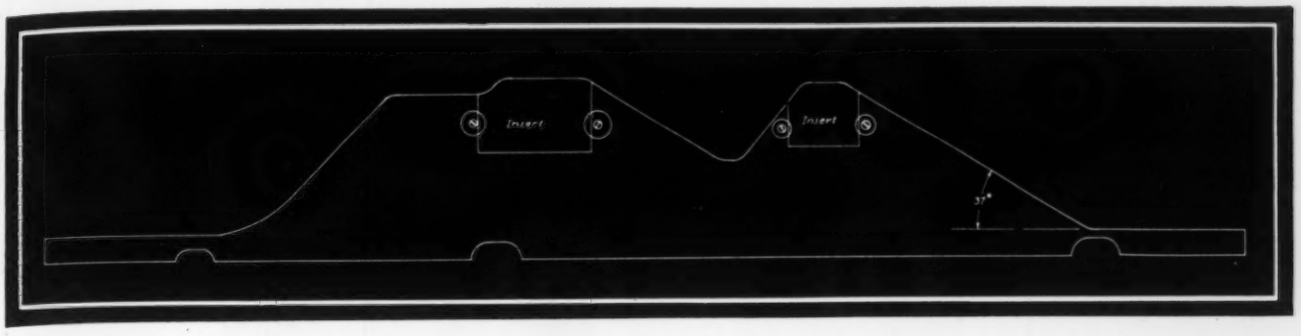

Fig. 4—Cam development permits incorporation of all necessary operations with a minimum of resistance to motion

rather than from the sides. A trimmer therefore is mounted on each spinner as an independent unit for each mold. This is a sleeve arrangement on the spinner that rotates continuously. After the final forming operation the sleeves and dies are lowered but the bottom of the die, so made as to be separate from the sleeve, actuated by the inner cam lifts the pots free of the sleeve and back into contact with the spinner. The trimming tool, lowered by a cam, cuts the fin off and smooths the edge with one sweep. At this point the finished pots are ready for ejecting, 270 degrees from the point where the clay ball was first placed into the mold.

The sleeve with the sides of the die now recedes to the loading or receiving position, but again the inner cam holds the bottom of the die at such a height that it will pass under the take off table. This take off table is a notched plate rotating in the opposite direction, the notches of which fit the pots. It is synchronized in the movement to catch each pot as the machine revolves, holding them by the ridge at the top. Various methods were tried to move the pots on to this plate. Sliding them by gravity would not work as the wet clay adhered to the surface. The pots had to be handled with care in order that no shocks would knock them out of shape.

Pots Are Skidded Off

The final solution is simplicity itself. The pots as they rest on the bottom of the die are not restrained in any way. They come into contact at this point with an arm which restricts their forward movement, received from the motion of the die base. They therefore slip along this arm through motion of the die and are skidded into the notched plate which can be adjusted to such a height that there is practically no strain on the pots when the suport of the die is removed. The plate carries the pots around to a conveyor belt where they are again skidded off. From this conveyor they are removed manually and stacked ready for the ovens.

From this point the base of the die, or ejector, is carried down into the die and is ready to receive the next charge. On all positions where the sleeve is carried down, it is not taken for granted that it will slide down by gravity. This method was tried at one time, but although it worked perfectly when the machine was traveling slowly, it was not dependable enough at high speeds, so a positive knock down cam was provided.

As the machine has to take care of the various sizes ranging from 1½ to 4 inches in 14 steps, different ranges of speed must be provided. The first thought was to use change gears. These were discarded, however, to allow for quicker

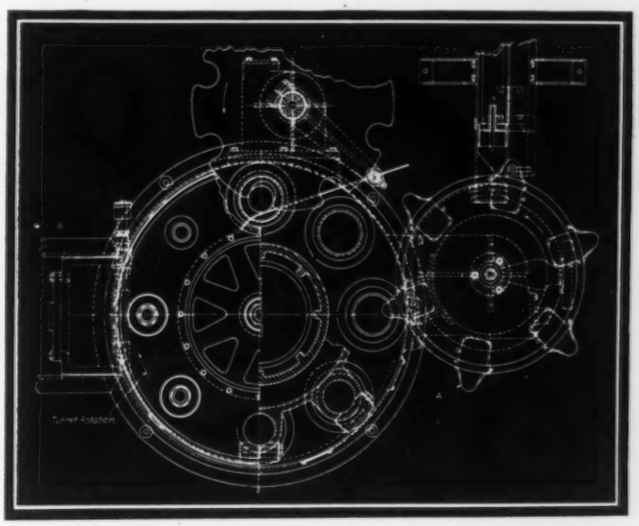

Fig. 5—Top view of turret showing location of loading troughs and take off table

change of speed and a wider range. A variable speed transmission, Fig. 1, was adopted. The transmission is an upright model having a special frame which permits it to be incorporated in the machine.

Due to the spindles being in a vertical position, considerable annoyance was experienced in holding back the lubricating oil. Lubricating oil, distributed by force feed, cannot be allowed to come into contact with the clay as it causes it to stick, only a fatty or lard oil being used on the dies. Several types of packing proved ineffectual until a commercial oil seal, *G*, Fig. 2, was applied. This was found so satisfactory that it has been adopted as standard equipment.

Do Societies Fail to Consider the Average Engineer?

By L. E. Jermy
Editor, Machine Design

THEORETICALLY the responsibility for the successful functioning of a technical society should rest upon its members. They enjoy the privilege of selecting a governing board to represent them in formulating policies and officers to administer the society's affairs in accordance with these policies.

In practice this theory of representative government falls somewhat short of its objective. As shown in the discussion in last month's issue, many engineers shirk their duties as members. Hundreds who are capable of holding office decline to do so. Thousands fail even to cast their ballots annually.

The result is that the average engineering society is guided by a minority group, the members of which usually make a sincere effort to represent the interests of the majority. This is a difficult task because it is almost impossible to sense the needs and desires of members who are largely inarticulate. The larger the organization and the wider the distribution of its members the harder it is to please all factions.

Most engineers who are qualified to pass judgment on the subject agree that in the main the administration of technical societies is satisfactory. However, when questioned as to certain details they believe there is room for improvement. The criticisms and suggestions embodied in the accompanying composite letter come from engineers who are widely distributed geographically, who range in experience from beginners to veterans, and whose rank in the profession encompasses all typical grades.

The concensus of their opinion seems to be that the average technical society does not render uniform service to its members. The complaint is made that engineers in remote cities do not and cannot under existing circumstances enjoy the privileges accorded those residing in large cities. There also is the implied charge that the society activities are designed to suit the more advanced members of the profession. The critics feel that the average member does not receive the consideration he deserves.

In this respect the problem of the technical society has its counterpart in practically every other form of human activity. It is the same problem that gives rise to the perennial debate as to whether university athletic policies should cater to members of the "varsity" squads or to the entire student body. It is the question of whether activities should be administered for those who elicit marked interest or for all eligibles regardless of their degree of interest.

Obviously the problem of those who direct society affairs is one of arousing greater interest on the part of a larger proportion of the membership. Several of the leading engineering so-

LAST month a number of technical society officials presented their views on the attitude of engineers toward association membership and activities. They showed quite conclusively that only a small proportion of members participate actively. In other words, a minority dictates policies and directs administration for the majority.

In this issue representative engineers suggest a few ways in which the management of society affairs might be improved. More attention for the "average" engineer is emphasized. The problem of "isolated" members is discussed. Apparently the key to the entire problem of participation lies in arousing greater interest among a greater number of members.

Fortunately there are signs of progress in this direction, due largely to attention to fundamentals forced by the depression.

—The Editors

cieties have attempted to do this through the organization of local chapters and the scheduling of frequent sectional meetings. These devices have helped considerably, but there still remain the members in remote cities and towns who cannot be reached through meetings.

The most logical appeal to these individuals is through society publications, yet many engineers seem to feel that engineering society literature is edited more for those who already receive a large share of benefits than for members residing at distant points who need the outside viewpoint more urgently.

That thousands of engineers necessarily are stationed at posts remote from congested industrial centers is a condition that will not improve. In fact, decentralization of industry may increase in the future. If it does the engineering societies will face an even more difficult task in fulfilling the needs of isolated members. We believe this is a problem meriting the most careful attention of society officers.

Numerous engineering organizations should be more considerate of the novice just out of college. Several societies enroll undergraduates in student chapters. This is advantageous in that it enables the student to get started in the right direction at an early age. However it is a mistake to think that this alone is sufficient to hold the engineer after he graduates.

"Finds atmosphere of meeting room decidedly chilly"

In summarizing the essentials in the subject of participation by engineers in technical societies it would seem that the keystone of success is the attitude of the engineers themselves. If a representative number in each branch of the profession recognize the advantages of membership in its accredited society and assume their duties as members, then success will be assured. If their attitude is right, control and direction of their society's affairs lie in their hands.

Until a greater proportion of eligibles take a larger measure of interest, the present rule by minorities must continue. The outlook for the future is promising. Most of the leading organizations are giving exceptionally good service in spite of the special difficulties of this period. Penetration of the wholesome influence of society membership is reaching deeper into the hidden recesses of many organizations than in the flush pre-depression days.

Necessity is cleansing some societies of superficial frills that were accumulated in years when ambition outdistanced good judgment. Attention to fundamentals never was keener.

In the main this forced introspection will be beneficial. It is focusing thought on the problems of the less fortunate members. When carried to its logical conclusion this study of present needs automatically will bring remedies to many minor defects now under criticism.

How We Regard the Technical Society—By a Group of Engineers

THE average engineer looks to his technical society for certain benefits which cannot be derived from any other source. These expected advantages include association with others of his profession on an informal basis, increase of knowledge through discussion at society meetings and through its publications, prestige due to membership and activity in the organization, a broadened outlook, and stimulated interest in the engineering profession.

As members of a group which is fairly representative of the fraternity of design engineers, we believe that the officers of the leading technical societies are trying conscientiously to provide most of these benefits for their members. In general the results are quite satisfactory but in detail there are a number of points wherein we think the societies are not making the most of their opportunities.

For instance, consider the plight of the young engineer just undertaking the obligations of his first membership in an engineering society. Does the organization do all that it should to help him off to a good start? We think not.

Imagine this new member attending his first meeting. He enters the meeting room, finding the atmosphere decidedly chilly. If he is early he sees a few members scattered around the room—as far apart as possible. They look at the newcomer with seeming hostility. In reality they are looking around in hope of seeing an ac-

quaintance. Nothing is done to break the ice. If, as often happens, the meeting proves to be dull and uninteresting the new member leaves with a feeling of disappointment if not disgust.

Not all young members would pursue such a passive attitude. Those who are naturally "good mixers" are seldom daunted by a cold reception. But many of the beginners in engineering are of a retiring disposition. In the first few years out of university they need encouragement. They lack experience in addressing their fellows in open meeting. A helping hand at this stage would be invaluable, yet few of those in charge of society activities have given adequate attention to this detail.

Another defect is found in the serious lack of uniformity in benefits derived by members due to geographical considerations. The head offices of technical societies usually are in large cities. Local chapters have headquarters in the metropolitan centers of each industrial district. Unfortunately, however, many of the members live in cities and towns so far removed from these central meeting points that it is difficult for them to enter into society activities on a par with their large city contemporaries.

We realize that the officials of the leading societies recognize this problem and have tried hard to solve it. The emphasis they have placed on regional meetings and

"Hold conventions in so-called 'exclusive' resort hotels"

on local chapter activities has helped the situation considerably, yet the fact remains that thousands of engineers in remote cities and towns are deprived of advantages enjoyed by other members. Unfortunately the isolated members really need the services of the society more than the members in large cities, many of whom would be able to fraternize with others of their profession even if there were no engineering societies.

Engineers who cannot attend meetings must rely on the publications of their society as a partial substitute for active participation. This being true, it would seem that the publishing policies of technical societies should take into account the real needs of the great mass of isolated members. We think most of the societies are open to criticism on this score.

From the standpoint of members, one of the bad features is the continual change of publication system without producing improvement. In bygone years the membership fee entitled the member to copies of practically all publications. Now he gets only a fraction of them, the remainder being procurable at an extra price. Eternal vigilance has to be exercised to obtain copies of everything needed, as articles of special interest frequently appear in unexpected places under unexpected classifications. An order for copies of all publications involves a bill along the general lines of the British income tax form. After the member has decided on a suitable plan of filing society publications, the next month's issue comes in a different size, or even if it is of the same size the contents are rearranged so that it is more difficult to find what is wanted.

A large and steadily increasing feeling of dissatisfaction is being built up by some societies through their publication policies. Sometimes members wonder whether certain societies haven't gone so far in their commercial publishing activities that their conduct of the organization for members has become an incidental sideline.

Many engineers have always felt that the qualification for membership in technical societies is not strict enough. The recommendation of several members usually suffices. One of the engineers contributing to this composite letter is identified with the electrical branch of the profession, yet during the past year he has received many invitations to join societies serving other fields, for which he was not specially qualified. When a society reaches out beyond its immediate field of prospects, one is inclined to think that the membership drive is prompted by commercial rather than institutional motives.

Suggest Importance of Grading

We believe greater attention should be paid to the grading of members. All workers in a profession are entitled to association in some form with its technical society. But in order to interest beginners and all intermediate classes up to and including the leaders there must be a recognition of relative standing. The following is suggested as a suitable classification:

1. Student member.
2. Junior member.
3. Associate member.
4. Member (life membership should be obtainable in this grade).
5. Fellow (or other suitable form of senior membership).
6. Honorary member.

To the foregoing might be added a group of "associates"—Those interested but not active in the work of the profession.

Once grades are established they should be adhered to strictly. One of the greatest opportunities for improvement in the average society can be found in the work of the membership committee.

Most of us subscribe to the often repeated criticism that some technical societies are too technical. Parts of the meetings and publications are "over the heads" of 90 per cent of the members. Frequently one sees several hundred members in a session listening to a paper which is understandable to probably not more than a score of specialists in the entire profession.

During the past 10 years many technical societies have held annual or other important meetings in so-called "exclusive" resort hotels. Here the item of expense discourages many members especially those who do not have recourse to expense accounts.

After all, the numerical strength of a technical society lies in its "average" members, not in the high-salaried leaders. We believe that the majority of societies have catered a little too much to the few in high places and not enough to the many in the middle and lower strata of the profession.

It is important that employers of engineers should understand the importance of technical societies. If they do not, it is difficult for their employes to participate wholeheartedly in society work. While the burden of "selling" technical societies to corporation presidents rests on the engineers themselves, the problem is one that technical society officers should study carefully.

Parabolic Versus Circular Arcs

By M. G. Van Voorhis

MECHANICALLY, a circle arc is simple to construct, but mathematically, other curves are simpler to plot. Since most design consists of straight lines and circular arcs it is natural to think first of the arc as a circle when a curve is required in design. If the difficulty of reduction of accuracy due to subtraction of nearly equal terms never interferes, no great advantage is gained by substituting another curve. Where such a thing is a factor, considerable time may be saved in computation by working out formulas from the parabola instead of the circle. Over short portions of the curve the deviation from each other can be made negligible if necessary but, while the circular arc may seem more desirable, the parabola can be substituted frequently and the difference never be detected.

Computations Greatly Simplified

The writer recently had to deal with the problem of designing three crane booms of certain lengths, one being standard and the other two shorter and longer, respectively, than the standard. The original boom was built with a taper in the plan view (the elevation had parallel sides at the center for the length to be removed) which meant that any change in length would require a reverse curve in the angles forming the corners of the boom. It was found that if circle arcs were used it would have been necessary to use either two pages of long-hand computation for each tie bar, or astronomical logarithms, the latter of which are not often found in engineering offices. The substitution of parabolic arcs reduced the computations practically to slide rule operation except in the determination of the equation constant.

The manner in which the parabola was used in this case may be of general interest and at the same time suggest a similar substitution in some widely different application. Figure 1*a* shows the original boom center lines and *b* the shortened boom from which the formulas for y were derived. It is not necessary to obtain the full width at any point because the length of the tie bar can be solved directly using the values of y. The x-axis was made the center line of the boom and the y-axis was placed at the start of the curve as shown. At first thought it would seem desirable to use that portion of the parabola starting at the symmetrical axis, but, since this required a rotation of axes through the angle α and complicated the derivation, it was decided to place the parabola at some unknown point and state the requirements that it pass through a point $(h, m—k)$ at angle α and through a second point $(h+c/2,\ (m+n)/2—k)$, these points being relative to a second pair of axes $(x_1 — y_1)$ whose origin is at the point $(x=—h,\ y=k)$ and on which the equation of the parabola is

$$x_1 = 2\ py_1 \qquad (1)$$

The slope of this curve at any point is the first derivative

$$\frac{dy_1}{dx_1} = \frac{x_1}{p^1} = \text{tan of the angle of slope}$$

and may be expressed for the angle α

$$tan\ \alpha = h/p \qquad (2)$$

Two other equations were written substituting the given points in equation (1) from which k was eliminated and the value of h from (2) substituted, leaving an expression for p in known quantities. From this point the development divided into two parts in which the equations for the two parabolas were translated from their

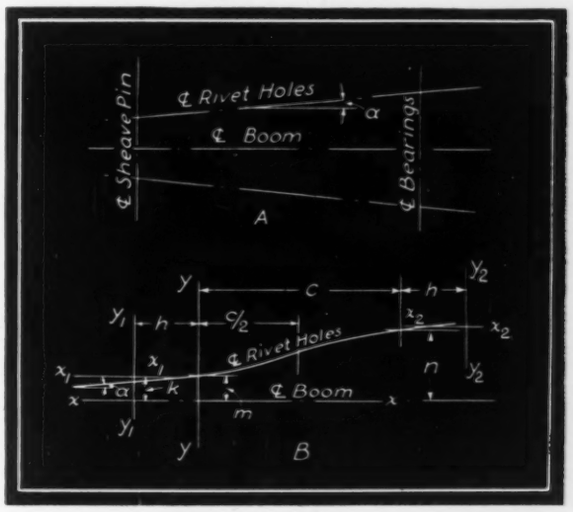

Fig. 1—A—Original boom shape and center lines. B—Shortened boom from which data for formulas were obtained

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Lubrication Should Be Considered in Machine Layout

By Harold B. Veith

Editorial Representative, Machine Design

Fig. 1—One of the new metallic base lubricants deposits a submicroscopical coating on the wearing parts

FAILURE of designers to take lubrication into account while machines are under development has resulted in many costly alterations later; in some cases in complete redesign. Lubrication engineers are being called upon constantly to deal with maintenance problems which reflect inconsistency with sound design practice. Out of this condition has arisen a closer liaison between the design and lubrication engineer, but in spite of this, numerous pitfalls exist which those responsible for design of machinery alone are expected to avoid.

When an engineer is consulted to make selection of a satisfactory lubricant and to prescribe a specific lubrication practice for a certain machine or piece of equipment which has been installed, he frequently is compelled to alter his preferred recommendation for the parts requiring lubrication to conform to other factors which the design of the machine imposes. Perhaps his experience has indicated that a certain type of bearing encountered is lubricated best with oil of certain characteristics, but because the bearing is not designed to retain oil of this kind or because no means are provided for applying any kind of oil, he must prescribe the use of a grease. Selection of a suitable grease is made, therefore, on a compromise basis with an effort to satisfy a number of opposed requirements by carefully balancing the bearing needs against the means provided for applying and retaining the lubricant. The correct selection, in such an instance, may hold the performance efficiency of the machine below its maximum capability by imposing comparatively greater friction losses, but this sacrifice is necessary in order to avoid other more serious difficulties.

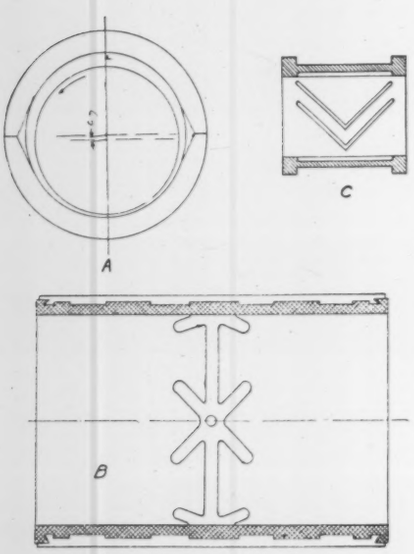


Fig. 2 — Chamfering the edges of a bearing segment as shown at A is good practice. Grooving such as that at B and C should be avoided inasmuch as grooves of this type sometimes conduct the oil away from the pressure area or break the continuity of the film

Correct Grooving Is Essential

One of the factors which still cause trouble is the grooving of plain cylindrical bearings. This practice originated in the days when such substances as paraffin were used as lubricant, grooves being made in the surface of the bearing to retain them. The grooves assumed the form of figure-eights, diamonds, loops, crosses, etc. Typical of these are *B* and *C* in Fig. 2, which generally should be avoided. As oil lubri-

cants came into use it was found that grooving continued to be essential and if the groove functioned as a pathway through which the oil was introduced at a point just before the pressure area it could be said to be correct. In many cases, however, the groove acted rather as a conductor which took away the oil from the pressure area or broke the continuity of the film.

As shown in Fig. 2*A* an oil groove formed by chamfering the edges of the bearing segment will serve to distribute the oil longitudinally and conduct it near the pressure area, as well as introduce it in the best shape for entering this sector. The oil reservoir established by such a chamfer furnishes oil in the form of a wedge along the length of the bearing, the small end of this wedge extending near enough to the pressure area to be drawn in between the surfaces. The same reasoning applies in the case of a grooved solid bearing.

Neglected Factors May Prove Costly

In locating the oil reservoir for circulating systems in a place which lends itself best to the layout of the machine, the designer should consider the necessary capacity and the provision for filtering. If the place he has chosen does not allow for a sufficient amount of oil to meet the requirements of the machine, trouble may ensue.

To prevent core sand from flaking off of the insides of cast iron housings and subsequently damaging bearing surfaces, it is good practice either to machine the inside of the housing and the oil conveying channels or paint them with some of the new oil insoluble paints.

Lubricants Keeping Pace With Design

Lubricants of greater stability have been developed in recent years to withstand the severe service of continuous use in oil reservoirs and in circulation systems with only occasional replenishment and renewal. These lubricants possess improved resistance to deterioration and increased ability to free themselves from contamination from outside sources. Their use assures maximum freedom from formation of detrimental deposits and sludges which sometimes accompanies the use of inferior quality oils. Greases, too, have been developed with greater resistance to high temperatures and to separation tendencies under unavoidable churning conditions. For conditions of overload on steel to steel gear sets and for the new hypoid gear drives, extreme pressure lubricants have been developed which withstand these severe pressures successfully.

Lubrication research has not been confined only to such matters as the perfection of oil films but has reached into the development of metallic base compounds. Unusual results have been obtained by employment of a lubricant of this type,

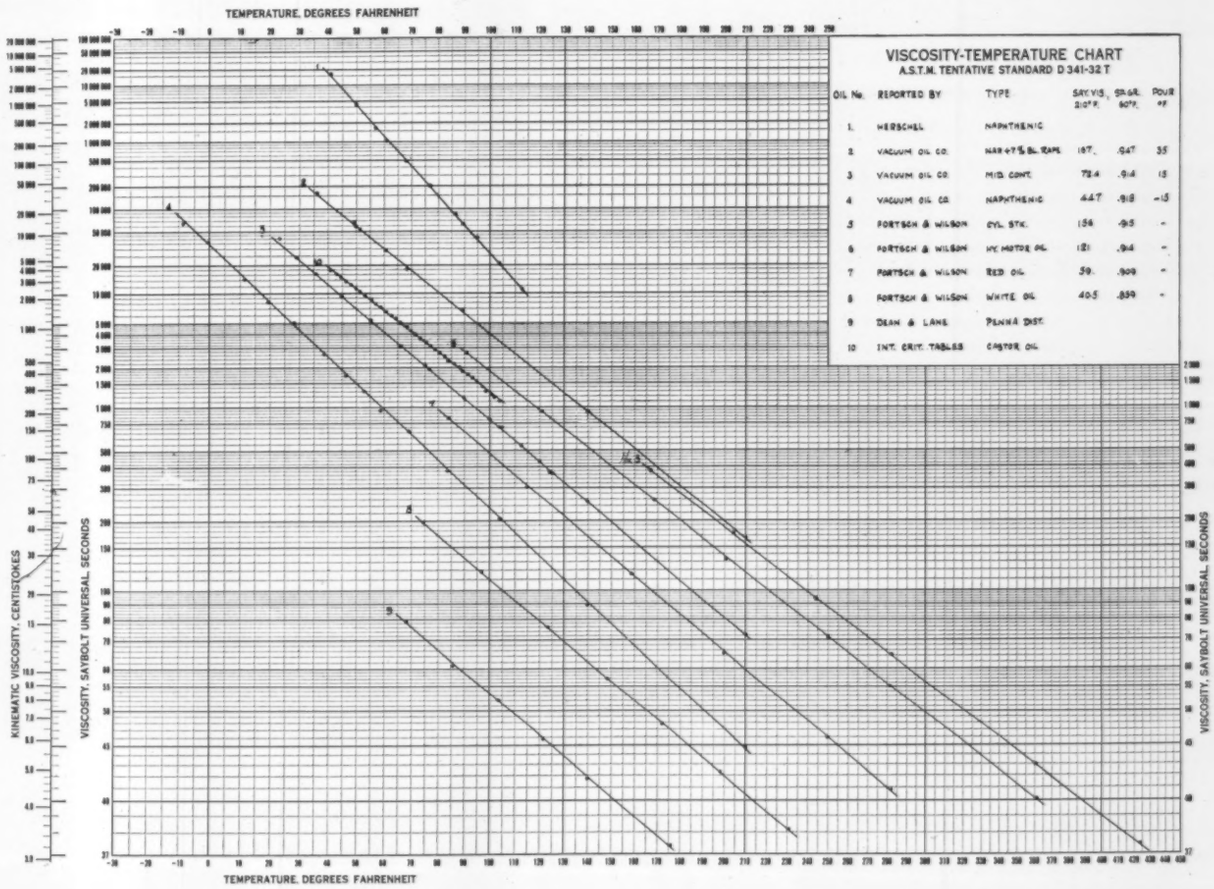

TEMPERATURE, DEGREES FAHRENHEIT
VISCOSITY-TEMPERATURE CHART
A.S.T.M. TENTATIVE STANDARD D 341-32 T
OIL No. | REPORTED BY | TYPE | SAY.VIS. 210°F. | SP.GR. 60°F. | POUR °F
1 | HERSCHEL | NAPHTHENIC
2 | VACUUM OIL CO. | NAP+2% BL. RAPS | 107. | .947 | 35
3 | VACUUM OIL CO. | MID. CONT. | 72.4 | .914 | 15
4 | VACUUM OIL CO. | NAPHTHENIC | 44.7 | .918 | -15
5 | FORTSCH & WILSON | CYL. STK. | 154 | .915 | -
6 | FORTSCH & WILSON | HY. MOTOR OIL | 121 | .914 | -
7 | FORTSCH & WILSON | RED OIL | 59. | .909 | -
8 | FORTSCH & WILSON | WHITE OIL | 40.5 | .859 | -
9 | DEAN & LANE | PENNA DIST.
10 | INT. CRIT. TABLES | CASTOR OIL
KINEMATIC VISCOSITY, CENTISTOKES
VISCOSITY, SAYBOLT UNIVERSAL, SECONDS
TEMPERATURE, DEGREES FAHRENHEIT

Fig. 3—Reproduction of viscosity-temperature chart sponsored by American Society for Testing Materials

having a zinc base, which deposits a submicroscopical coating on the working parts of machinery. Following four years of development in England and in this country the new product is arousing interest among machinery builders.

The reason for the deposition of the coating has been explained in the light of a phenomenon by which minute electrical discharges occur between moving parts in contact. These discharges are said to set up an electrolytic action by which the film of zinc is deposited.

Bearing surfaces become highly polished with the coating which is incapable of being measured except by laboratory means, and then only chemically. The film does not continue to build up as might be expected but remains of submicroscopical thickness. This new type of lubricant possesses considerable surface tension and its adhesive properties are notable; also its viscosity remains comparatively constant under changing temperatures.

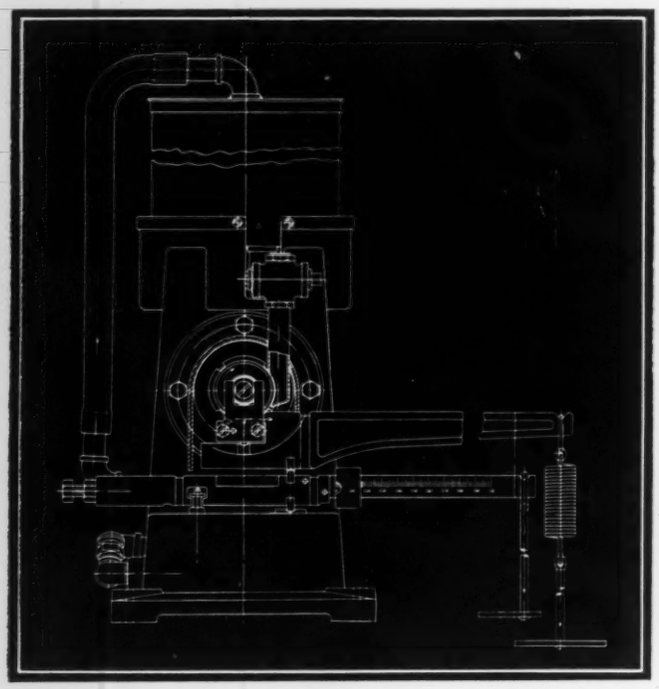


Fig. 4—Load carrying capacity of different lubricants may be determined by this recently developed testing machine

Standard Viscosity Chart Is Developed

To simplify the determination of viscosity at varying temperatures several charts have been devised. These have differed in size, method of ruling and system of units, with discrepancies resulting that sometimes were serious. In order to meet the need of accuracy as well as uniformity a viscosity-temperature chart has been adopted as a tentative standard by the American Society for Testing Materials. A reproduction of this is shown in Fig. 3.

Increased importance of friction and heat calculations in specifying proper lubrication has been responsible for unprecedented interest in this chart. Engineers are assisted particularly by the convenient, accurate kinematic viscosity scale which has been placed on the edge of the chart, making it easy to convert Saybolt seconds to fundamental viscosity units.

Extremely high pressures brought about by modern trends in design have created a need for machines to determine accurately the load carrying capacity of lubricants. A new wear and lubricant tester developed by Timken Roller Bearing Co., Canton, O., Fig. 4, is designed to show the comparative load carrying capacity of lubricants at constant rubbing speeds, and the maximum load which a lubricant will withstand before the film breaks down.

Engineers Present New Lubrication Data

That lubrication and lubricants are being studied more intensively is evidenced by developments disclosed at an informal conference held recently by the lubrication engineering committee of the American Society of Mechanical Engineers. Here was presented a theory which offers experimental proof of Langmuir's contention that a layer of lubricant one molecule in thickness is held by chemical forces to the face of the metal. Furthermore, it bears out the theory of French investigators supported by Sir J. J. Thompson, famous British physicist, to the effect that a comparatively heavy layer of oil is held to the metal by electrical or magnetic fields.

Discoveries in the behavior of lubricants, which have made possible the development of the new theory, resulted from tests conducted on a new machine erected by Sperry Gyroscope Co. for investigating lubrication phenomena. With the new machine not only has the presence of these heavy layers of oil been established, but the lubricant has been found to peel off layer after layer. Further it has been ascertained that an ultimate layer finally is reached which does not peel off even when tremendous disruptive forces have been applied.

Tests made by this new machine have given a basis for believing that lubricants, many if not all, consist of two parts; one performing the functions of the lubricant and the other acting as a collodial solvent. A concluding thought emanating from the meeting was to the effect that in order to handle lubricating problems more effectively it is necessary to possess precise knowledge of the behavior of metals toward lubricants and lubricants towards metals.

MACHINE DESIGN wishes to acknowledge the co-operation of Lubriplate Corp., New York, Standard Oil Co. of Indiana, Chicago, the American Society for Testing Materials, and the lubrication engineering committee of the American Society of Mechanical Engineers in furnishing data included in the foregoing.

Industry Demands Application of Advanced Technology

By John M. Lessells

MODERN trends in mechanical engineering constantly reflect the influence of increased scientific knowledge on design. Additional advances in technology necessary and steps planned to disseminate technical data are presented by Mr. Lessells, secretary of the Mechanical Engineers' Applied Mechanics division, and manager of engineering of the Westinghouse South Philadelphia plant.

WHEN the developments of Savery, Newcomen, Watt and others inaugurated the machine age, mechanical engineering largely comprised the ability to work with one's hands. Later on the mechanical sciences began to be developed in ever increasing branches which led to expansion of technology. Today we live in an age in which pure science is being developed at an extremely rapid rate and this is reflected in the tireless efforts to advance technology in ever increasing steps. This means that while a successful structure always will depend on satisfactory manual work, the successful engineer of today must, for the reasons cited above, keep himself familiar with contemporary scientific development.

In the early days of the machine age the engineer had time to profit by his mistakes and even obtain experience in the field as a result thereof. This was due to the comparatively slow rate at which industry developed. For example, when the steam engine was invented it could be built satisfactorily without any intimate knowledge being available on the thermodynamical problems involved in its operation. The designer of steam locomotives easily could, therefore, take advantage of the method of trial and error and correct the designs in the field. While this has been, and always will be true to some extent, the fact remains that the amount of the investment involved in modern machines necessitates having and applying more fundamental knowledge on all type of apparatus than was available or necessary in the early years. On the other hand, in contrast to this, the designer of the oil engine locomotive had to produce an engine which, at once, could obtain a reliability and economy superior to that of its steam rival.

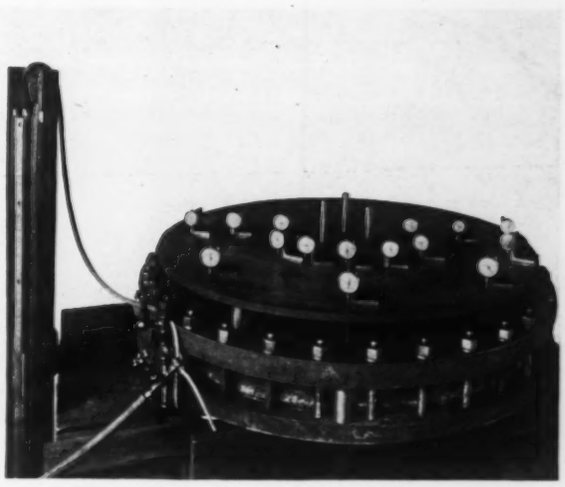


Fig. 1—Set-up for checking deflections obtained by analysis in turbine diaphragms

This means that the era of high speed has brought us face to face with new problems in mechanics which must be understood properly if satisfactory and economical designs are to result. Attention must be given to dynamic balance and vibration phenomena, and more knowledge of the distribution of stresses must be made available. We must know more about the underlying causes of failure of materials so as to prevent fatigue developing, while still believing in the possibilities of higher stress applications. Industry needs more science, and engineers must be tireless in their efforts to furnish us with more suitable materials for every purpose to open up new sources of power and to simplify and cheapen production. This only can be done if we keep fundamental concepts in view. In spite of all endeavors, new designs will contain certain features which could be improved with more knowledge of actual facts concerning them.

The need of industry for such knowledge is

seen clearly in the development which has taken place in this country in recent years in technical activities. It always has been appreciated that the work of the German schools in advanced theory played an important part in the rapid development of German industry, both in developing men trained to reason basically and also in providing welcome additions to the fund of scientific knowledge. It is no accident, therefore, that the bible of steam turbine theory is published by a German who has become a world authority on this particular subject.

Recently there have been distinct aims to remove the discrepancy which existed in this country between the needs of industry and the available knowledge, among which was the creation of the Applied Mechanics division of the American Society of Mechanical Engineers. This division encourages the presentation of papers dealing with the more fundamental side of mechanics embracing such phases as elasticity, strength of materials, hydrodynamics and thermodynamics.

To Discuss Velocities

Many interesting papers will be presented at the national meeting of the division to be held the latter part of June. For instance, the question of velocities higher than that of sound will be discussed. It will be shown by approximate calculation how pressure changes occur at the head of projectiles. The question of self-induced vibration will be presented, a subject of great interest to designers today and one which has been practically unexplored until now. Deflection of thin plates under hydrostatic pressure also will be discussed and it will be shown how the theory can be applied to the design of ships. Much attention will be given to the subject of plasticity which is of great importance to engineers in view of the advent of high temperatures and stresses.

Lately certain engineers have felt the need for more enlightenment on the subject of proper working stress values. It is well known that even with proper determination of the distribution of stresses in a structure which advanced theory gives, there is always a field of conjecture on the choice of working stresses, largely because we have a limited knowledge of the manner in which materials fail. The economic aspect has made engineers anxious to increase these working stresses just as far as safety will allow.

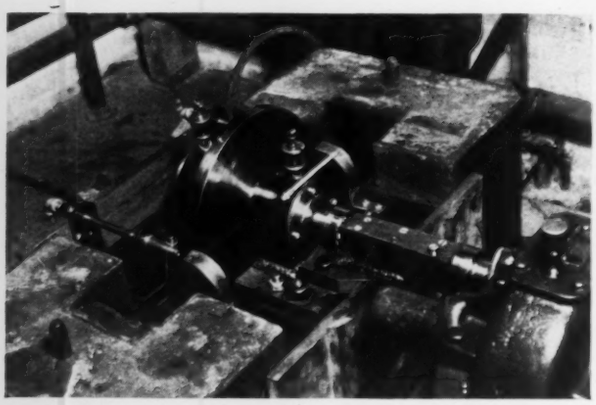


Fig. 2—High peripheral speeds increase erosion damage. This test equipment was built to study the problem

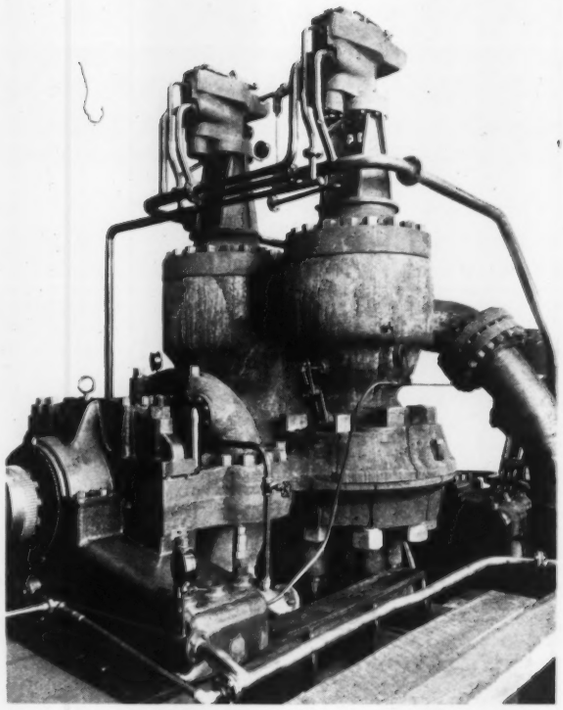


Fig. 3—Increased steam pressures and temperatures have brought about redesign of turbines

In the foregoing, we have discussed changes which have occurred in outlook of mechanical engineers during the last half decade. It is interesting to note how these general changes have effected design in general and particularly the design of a large manufacturer of electrical and power devices.

In recent years there has been a continued tendency to increase the steam pressure and temperatures in steam turbines with a view to improving efficiency. In the last twenty years the initial steam temperature has been raised from 600 to 850 degrees Fahr. and the initial pressure from 200 to 600 pounds per square inch, and a number of plants have steam pressures of 1000 pounds and over. By the use of the Benson boiler even higher pressures now are contemplated. Fig. 3 shows a turbine built for a steam pressure of 650 and temperature of 850 degrees Fahr.

This development has involved designers in investigation work which was not necessary before these temperatures were used. It has made it imperative to know more about the characteristics of the materials employed, particularly the phenomenon of creep of materials

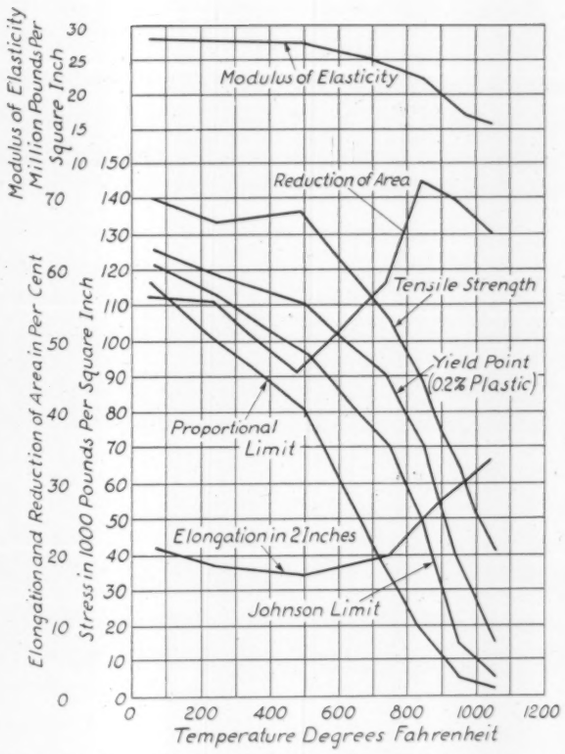


Fig. 4—Characteristics of material under prolonged stress and temperature

at high temperatures. The usual constructural materials, at the lower ranges of temperature, can be considered as elastic, although later investigations seem to indicate that creep takes place at all temperatures. Nevertheless creep, if it does occur at the lower temperatures, is not rapid enough to cause concern. At higher temperatures, however, it becomes a serious problem since all materials at such temperatures behave more like viscous fluids. This means that data of the kind shown in Fig. 4, giving the tensile properties of materials from room temperature to 500 degrees Cent., are not sufficient because it now is well known that most of constructional materials continue to creep if subjected to stress and temperature continuously. Creep probably occurs at all temperatures but the velocity of strain undoubtedly is increased with temperature rise.

Information on the characteristics of material under the action of prolonged stress and temperature therefore is necessary. Much of this kind of data now is available and the subject is being given continued attention by engineers[1]. Supplied with creep rates for one set of conditions of stress and temperature which are known by experience to be satisfactory, some idea can be obtained of the stress reduction necessary for new installations where higher temperatures are contemplated keeping the degree of safety constant in both cases.

Due to machining tolerances and the lack of perfect homogeneity in materials used, it is never possible to insure that the axis of rotation of a machine will coincide with the principal axis of inertia. Disturbing forces depending directly on speed therefore arise. It is well known that when the number of revolutions per second of a shaft coincides with the frequency of the natural vibration, a critical speed is reached.

Vibration Difficult to Explain

Even though this phenomenon is well understood, in modern turbines due to the increase in length between bearings, the problem of proper support gives rise to vibration troubles which even with most advanced knowledge, are sometimes difficult to explain. Great progress has, however, been made in recent years in the development of instruments which may be employed to obtain a better understanding of the above phenomena. Such difficulties cannot be solved by a mere increase in dimensions of the machine part. Application of advanced theory is essential[2], and hit and miss procedure would be dangerous and uneconomical.

The importance of having complete information on the distribution of stresses has been mentioned, but this implies a deeper knowledge of elasticity than contained in elementary treatises. This method is used in the solution of

(*Concluded on Page* 42)

[1]*Symposium on Effect of Temperatures on Properties of Metals*, American Society of Testing Materials—1931; and Nadai, *Plasticity*, McGraw-Hill Book Co., Engineering Societies Monograph—1931.

[2]Timoshenko and Lessels, *Applied Elasticity*, Westinghouse Technical Night School Press—1925.

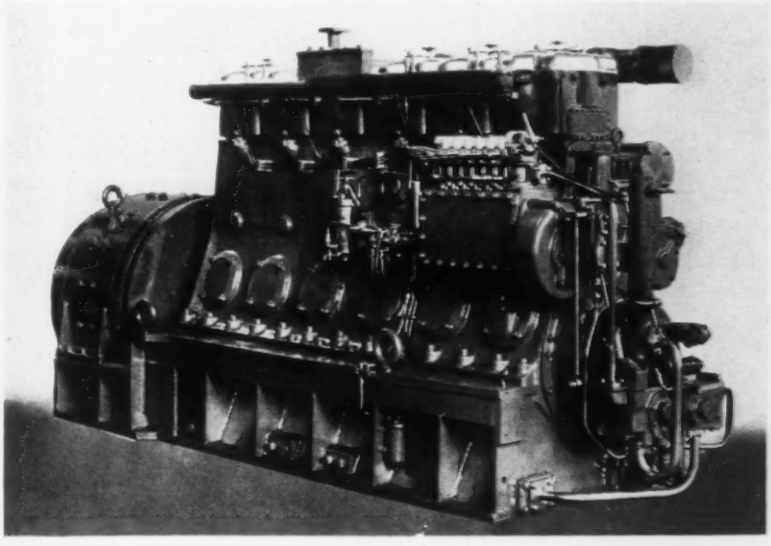


Fig. 5—Diesel engine of recent design operates at 900 R.P.M. with a fuel consumption of but 0.4 pounds per brake horsepower.

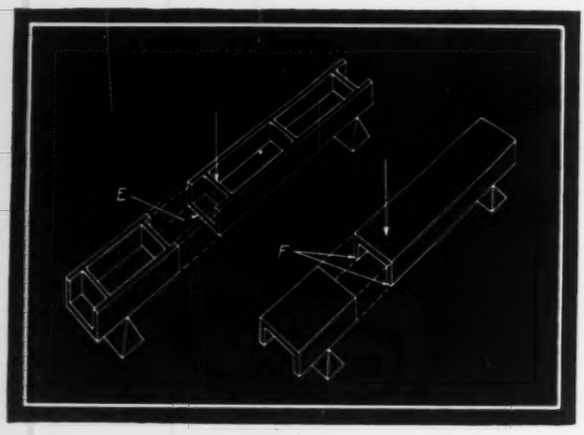


Fig. 1.—Approximately twice the load can be carried on box girders with plate side in tension as compared with open side in tension

Utilizing Tests in Casting Design

By F. C. Edwards

CONSTRUCTIVE testing is a distinct aid to the designer for with that tool he is enabled to gage the relative strengths of various forms. He proves that certain types of design give appreciably higher ratios of efficiency, weight for weight, than others; that in some circumstances, the addition of metal actually weakens rather than strengthens a casting; and conversely, that the judicious removal of metal may confer extra strength. Thus he is in a position to make the most effective use of the metal he employs, to achieve lightness, neatness and reliability. Some of the instances where these results have been obtained in the design of castings are related in the following, abstracted from a paper presented at a meeting of the Institute of British Foundrymen.

Carries Twice the Load

Tests have been carried out on miniature box girders, Fig. 1, to determine the relationship between the strength of this type of component with the load applied as shown by arrows, with the plate side in tension and with the open or ribbed side in tension. This research resulted in the determination that a similarly proportioned girder may be expected to carry approximately twice the load with the plate side in tension as compared with the reverse. If a casting was designed to carry inside mechanism and to withstand outside pressure, more economic design may be secured by arranging the frame with the ribs on the outside. In this way the tensional stress would be distributed over the full width of the plate and the ribs merely would be required to serve as compression members.

The superiority of a channeled girder over that of solid section is attributable partly to metallurgical causes. Removal of metal from the neutral axis of the component which causes a speeding up of the rate of cooling as well as promoting a more uniform cooling rate throughout the casting as a whole, gives a higher stress value, weight for weight, than possibly could be obtained with the rectangular section.

An actual case in which constructive testing, by demonstrating the superiority of certain features, not only secured a stronger casting but also effected a material saving of metal, is the casting for a triangular lever used in a road weighbridge, Fig. 2. Previous to the change in

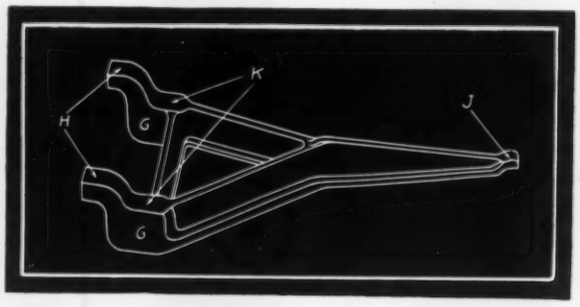


Fig. 2—This casting was redesigned and made approximately 20 per cent stronger with 168 pounds less metal

design these castings, subjected in service to severe shock stress, occasionally gave way. Since redesigning there has been no record of a single casting being fractured either in transport or in service.

It is important to note that the shock stress to which these levers are likely to be subjected in service is concentrated largely on what are termed the feet, *G*, Fig. 2. An enlarged sketch of one of these feet is shown in Fig. 3*a*. As a first step, helpful in constructive testing, consider the direction and approximate relative intensity of the stresses to be carried. The casting in service is suspended at the extreme centers, *H* and *J*, on suitable knife-edge bearings. Load is applied at *K*, Fig. 2. Since the distance between the centers *J* and *K* is about ten times that between *H* and *K*, the stress at *J* is but one-tenth that operating at *H*. Therefore, compared with the load on the feet, the stress at the nose end of the casting, *J*, may be ignored with absolute safety.

Fracture Possibilities Determined

Stresses on the feet operate in the direction of the arrows *L* and *M*, Fig. 3*a*. With the end of the lever resting on knife-edge bearing *N*, and the load on bearing *O*, it is easy to imagine that the casting would be most likely to fracture somewhere between the limits indicated by the arrow *P*, commencing at the corner *Q*, which we may term the tension flange. Preceding rupture, the metal at the outer surface *P* would thus be in compression. Practice supports this theory and fracture invariably occurs on the lines indicated in the drawing.

It should be observed that the feet as originally designed were cast solid, as shown in Figs. 2 and 3*a*. Dimensions were found by computing the stresses under which it was assumed the casting would operate, and by the application of a safety factor assuming a certain minimum strength for the metal.

A material increase in the strength of this casting may be secured by the removal of surplus metal. especially from the compression side of the foot. Since cast iron is considerably stronger in compression than in tension, the metal on the compression side in excess of what is necessary for the support of the casting before rupture occurs at the tension flange is not only wasted, but, by slowing up the general rate of cooling, definitely militates against the strength of the casting along the line of incipient rupture at the corner *Q*.

Such reasoning indicated a provisional line of action to be pursued in the constructive testing. To obtain comparative data, two half-size models of the feet were made, one solid and the other lightened by changing the contour to *R* and *S*, Figs. 3*b* and *c*, which represent side and end views respectively of the foot. Castings were made under the same molding conditions and poured from the same ladle. The castings were tested to breaking point, the load being applied in a similar manner to that to which the actual castings are subjected in service. The solid foot gave way under a load of 21,056 pounds while the lightened casting did not break until the load was 25,312 pounds.

Foot Strength Is Maintained

Rupture undoubtedly starts at the corner *Q*. The outer flanges *T* are thus merely compression members and the outer surface, although materially relieved, is still far less likely to yield under a compressive stress than the inner surface

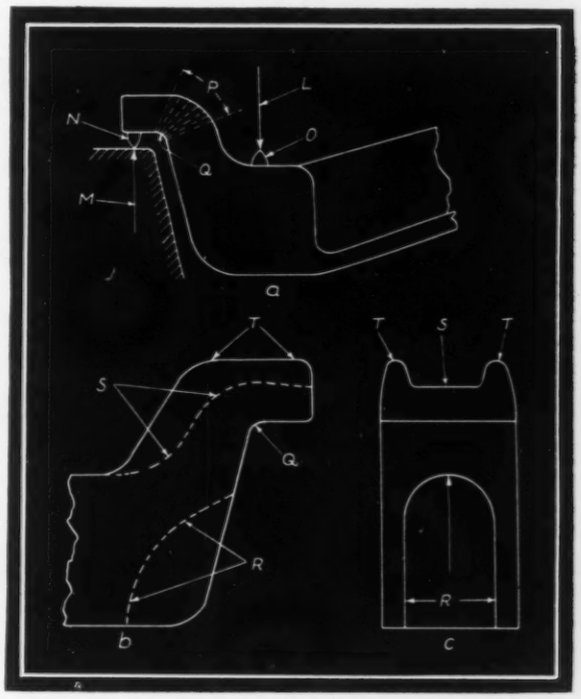


Fig. 3—a—Forces M and L act at points N and O causing rupture in section P. b—Side view of the redesigned foot. c—End view of the foot showing lightened undersection

at *Q* under a tensile stress. Even though metallurgical considerations are neglected, the removal of the metal does not militate against the strength of the foot. Regarded from a metallurgical point of view, an appreciable increase in strength is expected in the lighter section.

Simple tests have proved that the strength of a casting per unit area decreases with increase of section. The variation is a function of the rate of cooling. In this case, the removal of excess metal from the compression side of the foot, in addition to lightening the body at *R*, actually confers more than 20 per cent increase of strength upon *Q* by speeding up the general cooling rate.

Editorial

Do Not Overlook Significance of Style in Design!

TO observers accustomed to reading the signs of the times it is apparent that the function of design is undergoing significant changes. There is an undercurrent of unrest—an implied criticism that the old conceptions of design do not fulfill adequately the needs of the present period.

Thus far the rebellion against traditional ideas has progressed farther in the field of architecture than in the mechanical arts. The change is hard to define. The professions seem to be striving for design that expresses more than utilitarian considerations. They are seeking creations that satisfy demands for beauty, comfort, etc., as well as serviceability.

Indicative of this trend is the forthcoming first national exhibition of three-dimensional objects sponsored by the National Alliance of Art and Industry. Opening on June 20 at the Art Center building, New York, the exhibit is said to be timed to "a new era in industry in which the products of the machine are to be conditioned by good design." The products to be exhibited include pianos, washing machines, gas engines, electrical appliances, clocks and models of locomotives, automobiles, cars, etc.

This exposition is a logical result of the movement that started several years ago when a few manufacturers first turned to artists and style consultants to put the finishing touches on their products.

It is not to be expected that design engineers can function as artists or stylists. However, it is important that the results of machine design and art be harmonized. For this reason the work of the National Alliance of Art and Industry should be watched carefully by manufacturers and engineers whose products embrace the factors of beauty or style.

Tests Point the Way

THE increased attention being devoted to development of test methods is apt to have far-reaching effects on design. Some engineers have realized the advantages of methods such as X-ray testing and photoelastic observation of stresses in machine members, but these processes have not yet been given their quota of recognition due, to some extent, to the cost involved in purchase of equipment or in having the tests carried out.

Another process of testing is discussed on page 36 of this issue. Tests of the type referred to undoubtedly have their place, but we believe the day is not distant when they will be superseded or at least supplemented by the more scientific methods. Seemingly costly tests may effect worthwhile economies and warrant serious consideration.

Rudolf Diesel

Master Designers

Rudolf Diesel

FIRST of the scientific inventors, as contrasted with the brilliant tinkers who through trial and error have contributed so much to design, was Dr. Rudolf Diesel, inventor of the engine which bears his name, born in Paris of Bavarian parents in 1858. Diesel's engine was first worked out completely on paper as a rational application of theoretical principles and then, and not until then, was applied to experimental models. His object was achieved after thorough, painstaking calculation.

INSPIRATION for this effort was provided by a lecture at Munich Polytechnic school, where he was a student, on the wasteful methods of generating power extant at that time. Diesel made a note of the ideal engine and resolved to invent it. For 13 years he worked at night on his idea while employed during the day as an instructor at Munich and as a practical engineer. His plan of utilizing directly the energy created by the combustion of fuel, announced in 1893, created a sensation.

DIESEL was almost killed in an explosion resulting from efforts to start the first engine, but his injuries were, to him, relatively unimportant, for the accident proved that his theory on the combustion of fuel was correct, even though his method of harnessing the power was faulty. Four years of experimenting brought success and the second model performed excellently.

ENGINEERS hurried to see the engine, the greatest improvement in power generation since Watt, and one of the most remarkable products of human ingenuity. Applications soon multiplied, and Diesel was engaged busily in lecturing and demonstrating. In 1913, the British Admiralty summoned him to England for a consultation, but he was never to keep that appointment. He lost his life by drowning while crossing the English channel.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments and Questions from Our Readers. Machine Design Will Pay for Letters or Solutions to Problems Suitable for Publication

Creation of Demand

To The Editor:

YOUR editorial on page 50 of the April issue brings to mind the experience of a large stove company who sought to stimulate business not by redesign, but by introduction of a comparison line. Two years ago this company was dissatisfied with sales of higher priced stoves; so they decided to produce a low priced unit, a good stove yet without excess adornment, finished in attractive color combinations. The sales idea was to place this stove and one of the higher priced models on display so that the customer by inference or through sales suggestion would make a mental comparison, and by following sales tradition would select the higher priced model.

About this time the public was becoming distinctly price conscious and the result was that in 1930 approximately 50,000 of the new stoves were sold. Although according to cost records the new unit was priced without profit, the corresponding volume indicated that this business certainly was desirable. In 1931 a volume of 90,000 of these stoves was produced and the line showed better profits than the higher priced line.

The foregoing sales reaction was not the only thing this company learned. The demand for the low priced product enabled the production department to effect shortcuts with resultant lowering of manufacturing cost. I think this incident has the germ of an idea for other companies loath to adopt the lower priced idea or shackled to traditionally high priced products.

—J. M. MURPHY,
Lakewood, O.

Noise Creates Inefficiency

To the Editor:

THE editorial on this subject in the May issue should create interest among all men in the industry, for if there is any other problem in the modern shop that is receiving more notice today, I do not know what it is. There has been much said both pro and con on the subject, and the majority of us, representing the smaller shops who cannot afford to experiment with such problems, will be glad to read the opinion of men who have made a study of noise.

I for one am glad that MACHINE DESIGN intends to run a series of articles on this timely subject, for they will be extremely helpful to the larger shop as well as the smaller.

—CHARLES R. WHITEHOUSE,
Boston

Simplifying Task of Finding Tracings

To the Editor:

COMMENTS of F. A. Firnhaber in the April issue bring attention to a condition of considerable importance which is met with, at least occasionally, in the inability to locate a tracing quickly when it is wanted.

Ability to find tracings quickly depends primarily upon a simple system of numbering or other identification, a comprehensive system of cross-indexing, uniformity in the method of filing data from different departments, the standardization of drawing sizes, and mechanically convenient filing cabinets. Presupposing the existence of all of these, (yet wondering if all ever do exist in any one filing department), the finding of tracings then depends on accuracy of filing and the keeping of a record of all tracings removed from file.

It seems that the only infallible way to follow up tracings taken from the file is to have the tracings issued by one person who takes a receipt signed by the person taking away the tracing. These receipts should be filed numerically in a card index and then removed from the card file and destroyed when the tracing is returned.

The "honor system" is a modification of this. The writer has observed the satisfactory working of such a system conducted in the following manner: A 3x5 card index file sits on a table at the entrance to the vault where tracings are filed. On top of this card file is an open box con-

taining blank form cards printed identically on both sides in an addressograph machine. Space is provided to show drawing, order or estimate number, file drawer number, name of person and date. Any person who takes data from the vault fills out one of these cards and drops it into another open box. These cards are filed twice daily in the card file. Data returned for refiling is placed on a table adjacent to the card file and is checked off before return to the vault. When one side of the card has been filled out, the reverse is used.

Naturally, the system is not infallible. However, by following up each infraction and notifying either directly or through his department head, each person guilty thereof, occurrences of "lost" data have become remarkably few.

—Wm. C. Willard,
Buffalo, N. Y.

Sales Features and Steady Business

To the Editor:

THE editorial entitled "Steady Business Cannot be Maintained on Sales Features Alone" in the April issue, and the illustrations cited, should cause many manufacturers to reflect. I have personal knowledge that the cases given were not exceptions, for I have been employed in many shops where the executives and engineers were as good as could be found, yet similar incidents occurred.

The illustrations can be extended to work done for outside companies where the trouble with most manufacturers is that they accept a job from a customer, take his design assuming that he knows his business, and go ahead and build; then take the "bugs" out of the design at their own expense. Or, if they check the design and drawings and find something they think is impractical, they are timid about taking it up with the customer for fear he will think they are intimating that he does not know his business.

Jobs of this type where the work is being done from the customer's design should be taken into the shop and passed to the engineering department with the assumption that here is a new thing that must be taken apart and analyzed. If anything is found that is wrong or impractical then the customer should be notified. He will, in all probability, thank you for your help; but if he is the type that gets "huffy" over profferred assistance, then it would be better to lose the job. Poor work, even if it is the customer's design, is an extremely poor advertisement. One customer lost through trying to point out the error of his ways will in time gain many times the lost business.

—Charles R. Whitehouse,
Boston

Industry Must Now Apply Advanced Technology

(*Concluded from Page* 35)

many problems in steam turbine design. The results obtained by such analysis usually are supported by laboratory tests either on models or on the actual machine part. A set up for checking deflections obtained by analysis in steam turbine diaphragms is illustrated in Fig. 1.

In the forty years which have elapsed since Ackroyd, Stuart and Diesel invented the injection engine, a complete revolution has occurred in diesel engine design. The fuel consumption was then 0.9 pounds per brake horsepower and the engine weight was 200 lb/BHP. The engine speed was 200 revolutions per minute and the mean effective pressure 100 pounds per square inch. Due to research work on fuel spray and combustion and the development of mechanical ignition, we have engines today which operate at high speeds 1000 to 2000 revolutions per minute, give fuel consumption as low as 0.35 lb/BPH and weigh less than 20 lb/BPH, as in the case of the Deutschland. In the case of engines for aviation purposes, this weight has been reduced as low as 3 lb/BHP.

Rational Solution Necessary

Such development could only have been accomplished successfully by rational methods in the solution of such problems as bearing design, liner wear and proper atomization. Fig. 5 shows an engine having six cylinders 9-inch bore with a 12-inch stroke which has been developed recently for locomotive and rail car purposes. This engine operates at 900 revolutions per minute with a fuel consumption of 0.4 lb/BHP and weighs 35 lb/BHP.

To name only one of the problems which was encountered in this high speed engine and which could be solved only by fundamental reasoning, we take that of torsional vibration of the crankshaft. Here analytical work was done[3] and laboratory experiments made with the result that designs of suitable dampers for any engine have been rationalized. As a result, the damping of torsional vibration in engines is no longer a problem for the designer.

We are now in an era of rational mechanics in design. To satisfy all the needs of such methods, it is, of course, necessary to have men trained in such a way that they can take full advantage of the fund of knowledge which modern science and properly equipped research laboratories are making available. Such methods, actively pursued, eventually will bring success.

[3]DenHartog and Ormondroyd, *Torsional Vibration Dampers*, Proceedings of American Society of Mechnical Engineers, Applied Mechanics—1929.

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

WITH the recent coal convention and exposition of the American Mining congress in Cincinnati bringing to light new developments in the industry, there is an element of timeliness in the subject of mine mechanization and unemployment. G. B. Southward writing in a recent issue of the *Mining Congress Journal* points to statistics compiled by the bureau of mines to show that machines have not deserved the criticism directed against them.

Mechanized loading, he says, started in 1923, and a comparison between the tonnage loaded per man-day in that year and in 1930 (the latest figures available) shows the very small effect that machines have had on the production rate of the country as a whole. In seven years the total average production rate of all men underground has increased only 8 per cent. Certainly, says Mr. Southward, this is not the main cause for unemployment and any nationwide movement to discourage machine work would not be the remedy. One of the main reasons for the trouble is that the production of coal in 1931 had declined almost 200,000,000 tons per year under the production of 1923.

"Even if the elimination of machinery could bring about the employment of more men or more man-hours, it would not be of any help. There is a certain amount of coal used and purchased for which a certain amount of money is received. To decrease the production per man would create more work but it would not cause more money to be paid. The total amount of wages still would be the same and there is no particular advantage in working a longer time unless the pay is to be increased proportionately."

* * *

Compiles New Data on Mechanical Springs

PRESENTATION of a report by the special research committee on mechanical springs at the next annual meeting of the Society of Mechanical Engineers has been announced by John R. Townsend, chairman. The program, nearing completion, includes improved methods of computing helical springs, evolved from metallurgical and mechanical test data obtained in fatigue tests on full size springs.

A subcommittee now is preparing a program of tests of wire springs which will involve correlation of fatigue tests on full size springs with previous tests made on material, and will consider methods of test for springs, spring design formulas, and a comparison of alloy versus plain carbon steel for such springs.

As a result of his experimental determinations at Union college of the elastic constants of a variety of spring materials, including both steel and nonferrous metals, Prof. M. F. Sayre is working out a new code of design. This will give the most accurate spring constants thus far developed.

* * *

Gear Makers Observe Fifteenth Birthday

CHARACTERIZED by the same element of enthusiasm that has carried it through 15 successful years, the American Gear Manufacturer's association celebrated its crystal anniversary at Hotel Statler, Cleveland, recently. The meeting reached a climax at a dinner in the evening of the opening day when E. W. Miller, Fellows Gear Shaper Co., was announced as the new president succeeding B. F. Waterman. A picture and biographical sketch of Mr. Miller appear on pages 44 and 45 of this issue.

Outstanding among the reports of technical committees was the proposed recommended practice for computing the allowable tooth loads of metal spur gears. Prof. Earle Buckingham, chairman of the committee, presented it. According to the proposed procedure, which is a departure from the old practice, load carrying ability of a pair of spur gears may be limited by either beam strength of the gear tooth or the surface fatigue limit of the material. The lower of these two values in any particular case should be used to establish the load carrying ability of any given pair. Noise of operation usually is a good test for the accuracy of gears, the data brings out. Gears which are to be run at pitch line velocities of 5000 feet per minute and over cannot have errors much greater than .0005-inch, otherwise the noise of operation will render them unsatisfactory.

A set of gearing inquiry blanks covering bevel, spiral, helical, herringbone, railway and spur

(*Concluded on Page* 56)

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

GEARS, their design and manufacture, hold a fascinating interest for Edward W. (Ted) Miller. No phase, regardless of how technical or problematical it might be, is beyond the bounds of his scope of knowledge on the subject. Pressure angles, loads and stresses in gearing are everyday routine and his ability to cope with them has made him a leader in the profession.

That he should some day become the chief executive of the American Gear Manufacturers' association was inevitable. Mr. Miller's enthusiasm and activity in the organization presaged that. The presidency was accorded him at the recent meeting in Cleveland and concurrent with this honor he celebrated his twelfth year as an A. G. M. A. member. He also is affiliated with American Society of Mechanical Engineers and the Society of Automotive Engineers.

Mr. Miller holds another record which distinguishes him. Since his graduation from high school in Torrington, Conn., in 1898 he has been with the Fellows Gear Shaper Co., Springfield, Vt., without interruption. Torrington was the place of his birth, May 26, 1880. Following an apprenticeship at the Fellows company he was transferred to the engineering department. After gaining experience with various technical aspects of design and production of gears and gear manufacturing equipment he was made chief engineer. That was in 1915. Since that time he has been instrumental in the development and growth of the company.

FIFTY years of employment with practically one concern—in one line of business—is the notable record of J. Edgar Lee, president of Challenge Machinery Co., Grand Haven, Mich. Born in Chicago, Jan. 7, 1866, Mr. Lee commenced work with Shniedewend & Lee, electrotypers and printers, in March, 1882.

Eleven years later he became manager of Challenge Machinery Co., successors to Shniedewend & Lee. The business was moved to Grand Haven in 1903, was expanded to include the development of machinery, and in 1917 Mr. Lee became its chief executive. During his long association with the company he has spent much time in invention and design of equipment used in the printing industry, and has been granted upwards of 20 patents. He made a specialty of designing plate mounting systems and registering devices, particularly as they relate to register for color printing.

AFTER academic work which led up to a degree of doctor of philosophy and membership on the staff of the Massachusetts Institute of Technology, Frank B. Jewett in 1904 joined the American Telephone & Telegraph Co. as a member of the engineering department. Ensuing years of his career have been marked with engineering achievements, indicative of the importance of which was inclusion among the honored guests at the recent opening of the new patent office in Washington.

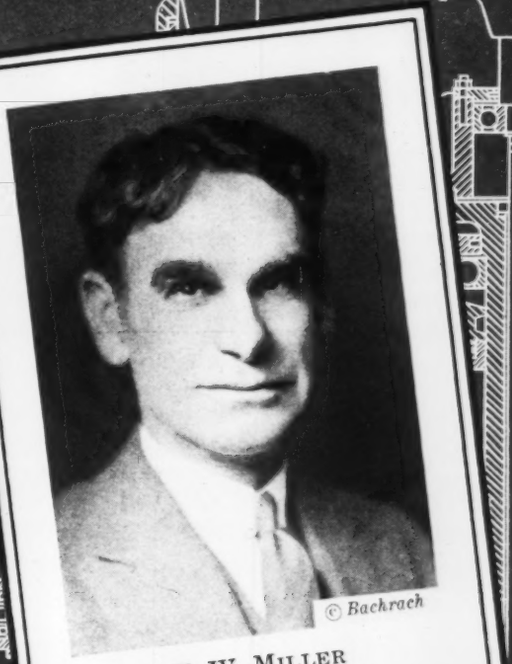
Beginning in 1912 with his appointment as assistant chief engineer of Western Electric Co., Dr. Jewett built up one of the largest industrial research organizations in the world. In 1916 he was given full charge of this department and in 1922 became vice president of the company. With the organization of the engineering department at Bell Telephone Laboratories in 1925, he became president of the new corporation and also was made vice president of the American Telephone & Telegraph Co. in charge of its development and research activities.

Dr. Jewett's chief contributions to science have been the idea of co-operative research and the skill to further that conception. He is aware that no one man can know everything or possess all kinds of skill; hence his idea of assembling groups of experts to work on complex scientific needs. The Bell Telephone Laboratories testify to his success.

ELECTION of Gen. T. S. Hammond, president and general manager of Whiting Corp., Harvey, Ill., as the new president of the American Foundrymen's association, places at the head of that organization a man of versatile ability. The fact that he is past president of the National Founders association and Foundry Equipment Manufacturers association indicates his leadership in the machinery field.

Born at Crown Point, N. Y., Oct. 29, 1883,

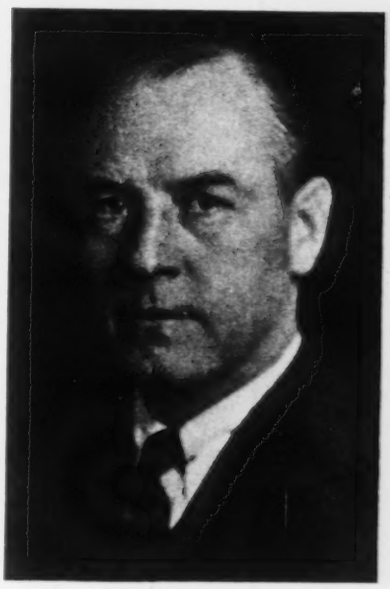
Leaders in Design, Engineering and Research



E. W. MILLER

J. EDGAR LEE

F. B. JEWETT



T. S. HAMMOND

Gen. Hammond received his preliminary education at Chicago. After graduation from University of Michigan in 1906 he entered the employ of the Whiting Corp., advancing successively as purchasing agent, assistant secretary, vice president and secretary, vice president and treasurer, and finally president. He also is president of National Engineering Co., Swenson Evaporator Co., Grindle Fuel Equipment Co., and the Joseph Harrington Co., all of Chicago.

Gen. Hammond has had a distinguished military career, first on the Mexican border in 1916 and overseas for 18 months during the World war. As a brigadier general he commands the Sixty-fifth Infantry Brigade, Illinois National Guard. An active part has been taken by Gen. Hammond in the Foundrymen's association, he having served on various committees, one term as director and one year as vice president.

* * *

R. E. W. Harrison has resigned as sales engineering director of Cincinnati Milling Machine & Cincinnati Grinders Inc., Cincinnati. He had been with the Cincinnati Milling Machine Co. since 1926, joining the organization as chief engineer and director of Cincinnati Grinders, Inc. Prior to 1923 Mr. Harrison was with the Churchill Machine Tool Co., England, as assistant general works manager and later commercial manager.

* * *

Cloyd M. Chapman, consulting engineer, New York, has been nominated for president of the American Society for Testing Materials for the coming year. W. H. Bassett, metallurgical manager, American Brass Co., Waterbury, Conn., has been named for vice president. Results of a mail ballot will be announced at the annual meeting of the society in Atlantic City, N. J., June 20-24, although nomination virtually assures election.

* * *

F. Hughes Moyer, recently president of Mackintosh-Hemphill Co., Pittsburgh, has been elected vice president in charge of engineering succeeding W. L. Ditges. Col. J. S. Erwin has been elected president of the company.

* * *

William S. Monroe, past president of the Western Society of Engineers, has been elected a trustee of Armour Institute of Technology.

* * *

Halvor Olsen Hem, consulting engineer, Toledo Scale Co., Toledo, has been awarded the John Price Wetherwill medal by Franklin Institute. The award was made "in consideration of the ingenuity shown in perfecting scales of the pendulum type, improving their accuracy, reliability and sensitivity, and for the application of these scales to specific purposes."

* * *

Cornelius P. Whalen now is engaged in special research engineering work, having resigned recently as vice president of Minerva Automobiles Inc., New York.

* * *

A. A. Dicke, patent attorney for Remington Arms Co. Inc., 25 Broadway, New York City, has resigned to take up the general practice of patent law, particularly engineering patents.

* * *

H. W. Gillett, director, Battelle Memorial institute, Columbus, O., was awarded the W. H. MacFadden gold medal during the recent annual meeting of the American Foundrymen's association in Detroit.

* * *

William D. Drysdale recently became chief engineer of Electric Devices, manufacturer of household ice machines. He formerly was superintendent in charge of manufacturing and assembling, Whitehead Refrigeration Co., River Rouge, Mich.

* * *

G. K. Viall is in charge of the laboratory installed by Chain Belt Co., Milwaukee, to carry on experiments in connection with the production of new alloy metal which the company will produce under license from the Industrial Furnace Corp., Buffalo.

* * *

T. W. Owen, secretary of the American Gear Manufacturers' association for the past 10 years, has resigned. J. C. McQuiston, formerly general advertising manager of Westinghouse Electric & Mfg. Co., has been appointed to take his place. Offices of the association will be moved from Cleveland to Pittsburgh.

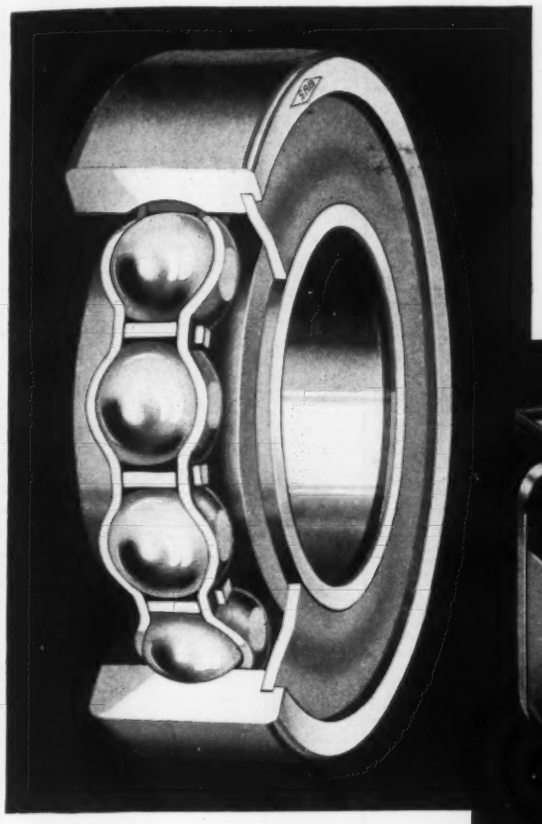
* * *

W. R. Mau, Vanadium Alloys Steel Co., Latrobe, Pa., was elected president of the American Machinery and Tool institute at the recent annual meeting in Chicago.

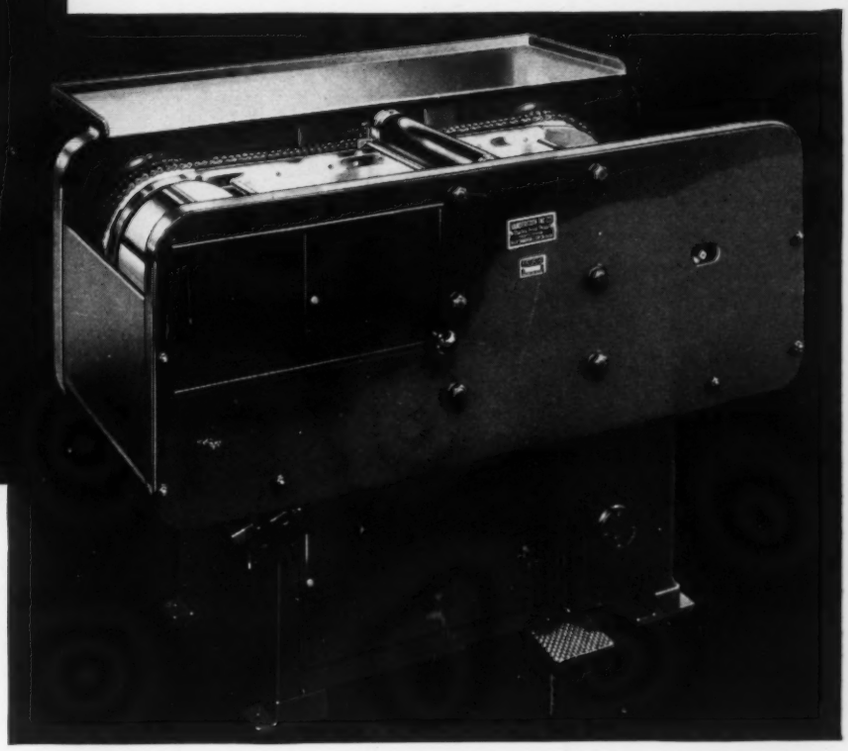
* * *

H. S. Woodruff has been appointed engineer in charge of the design section of the newly formed air conditioning department of the General Electric Co. He first came to the company in 1913 from Wayland Academy, taking a position with the railway control design department. During the war, he was engaged in special work, particularly in the field of munitions manufacture.

A HOLIDAY *for* OIL CANS!



43 SRB *Lubri-Seal* BALL BEARINGS *practically eliminate Further Lubrication*



VANDERCOOK & SONS, Inc., use 43 SRB Lubri-Seal Ball Bearings in their electric proof press . . . giving their users 43 reasons for longer life, greater accuracy and higher speed. The shield of the SRB Lubri-Seal keeps the lubricant in the bearing chamber . . . prevents waste through leakage . . . makes relubrication necessary but once each year.

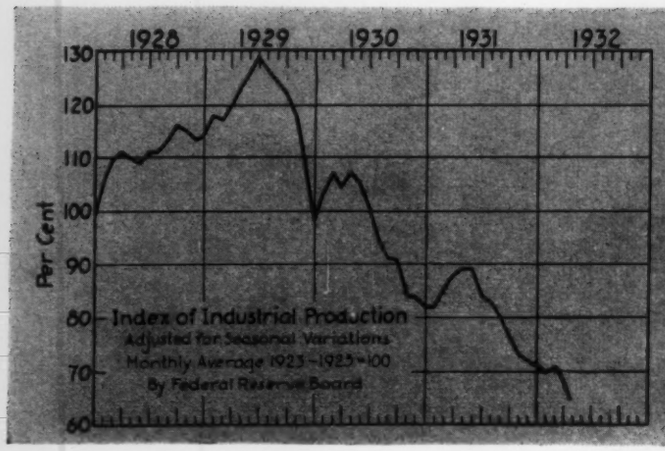
Vandercook are making sales on the strength of the additional life and operating efficiency obtained with SRB Lubri-Seal Ball Bearings. Prospective customers are influenced by the lubrication and maintenance savings—accuracy and high production qualities of this machine.

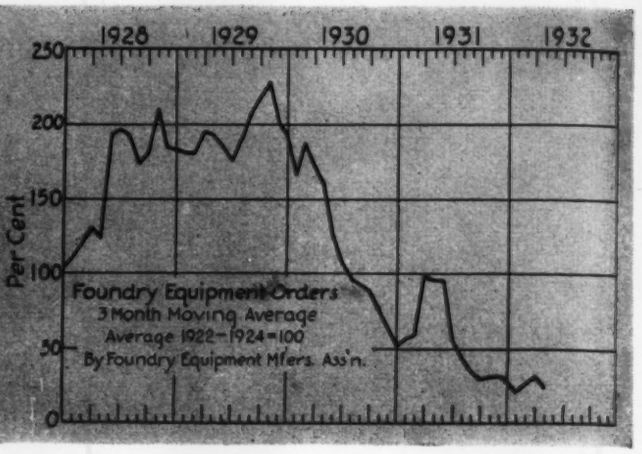
For more than six years SRB Lubri-Seal Ball Bearings have been providing similar economies and sales advantages in every type of industry. Millions of these bearings have rolled up service records that stand as conclusive proof of the sealing efficiency of the SRB "time-tested" shield design. Consider your own product . . . let SRB Engineers add the convincing economies and sales advantages that go with "Lubri-Sealing."

STANDARD STEEL AND BEARINGS INCORPORATED, *Plainville, Connecticut*

Division of Marlin-Rockwell Corporation

Ball SRB AND M·R·C **Bearings**



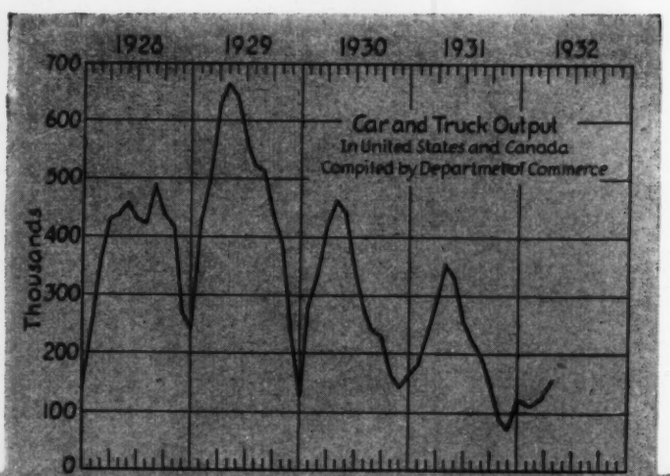


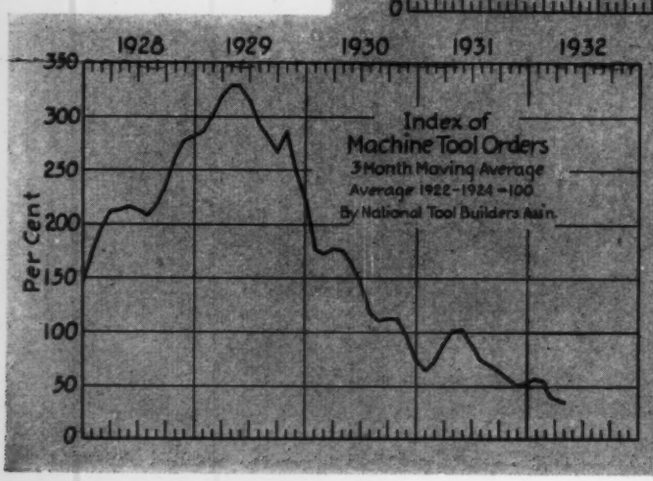
How Is Business?

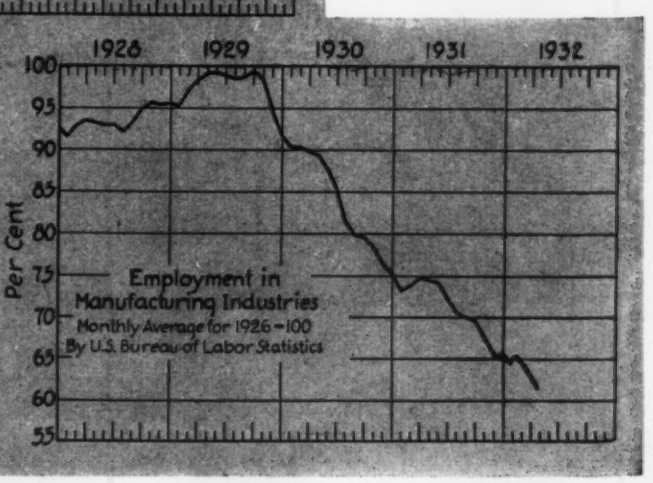
POTENTIAL markets for all classes of products have been increasing at such a startling rate that as a whole they are no longer news, yet the enormous increase in the potential demand for steel sets this field apart. The twenty-one year per capita production, including many lean years, is 775 pounds, but for the last six months the industry has been producing only 135 pounds per person.

Forty-two years ago, in 1890, the per capita output was 152 pounds, about 10 per cent greater than it is today. And in those days the railroads were the only outstanding customers of the industry. Today with obsolescence sucking the life blood of thousands of production machines the accumulated demand in this field alone far exceeds the meager total of those early years. The steel industry is a basic supplier for every machine manufacturing plant in the country.

The shaking loose of the orders concealed in this demand will depend considerably on the price factor. In a falling market buyers, naturally, wait out the sellers and purchase only the material actually required. A rising market will provide the psychological reaction necessary to stir purchasing agents to place orders before the price is even higher. The steel industry, having for months sold at sacrifice prices, now is definitely contemplating an increase of $1 a ton for third quarter releases. Should this increase hold and give promise of still further increases in the near future, other industries should soon follow.







Why Diamond Saves on Every Drive

Typical Multi-Strand Diamond Chain Drive

Permanent Speed-Ratio

Diamond Roller Chain Drives are positive—cannot slip nor creep. Speed-ratio between machines or units of machines can never change. . . . Production stays at the top.

Efficient

98%-99% of applied power is delivered to the driven shaft continuously—their efficiency is not decreased by length of service. . . . There is no "lost" power.

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Lengths of chain can be selected to meet your center distance requirements. . . . Ratios as high as 9:1 and in some cases even higher are practical. Diamond Roller Chains will run over or under sprockets in either direction—they can be applied to internal drives because installation and replacement can be accomplished without dismantling of the machine.

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Dependable under any or all weather conditions. . . . Hot days, cold days, damp or dry are all the same to Diamond Drives. Too, they can be supplied, made of special corrosion, or acid resisting materials for unusual applications.

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Requires less space, diameters and width, than any other drive, per h. p. transmitted—wherever centers are separated more than a few inches.

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Diamond Drives are quiet—they are used as Timing Drives on some of the costliest automobiles!

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Easy to order because drives for all usual needs are carried in stock in leading industrial centers. Mail coupon for complete information and Booklet No. 102-B. Diamond Chain & Mfg. Co. 435 Kentucky Ave., Indianapolis, Ind.

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[A-6561]

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

MERCURY switches and solenoids are employed ingeniously in an automatic control mechanism for stopping one or both of two associated can machines in case mal-operation occurs in either unit. Shown in Fig. 1*Y* is the clinching machine *A* for assembling the can tops on the filled can bodies, and its associated machine *B* which is known as the vacuumizing and seaming unit.

Occasionally a filled can passes through the clinching apparatus without receiving a top. Unless the machine is stopped immediately the can would be fed into the vacuumizing and seaming machine where the contents would be spilled and other difficulties encountered. Therefore, the newly invented device provides means for stopping the clinching machine when this occurs without interfering with the operation of the vacuumizer. The automatic control also is designed to stop both machines in case the vacuum fails in the seaming machine *B*, Fig. 1*Y*.

In the cycle of operation can ends *a'* are arranged in a stack, Fig. 1 *Y*, contained in a holder a^n from which they are fed to the open upper ends of the cans and clinched by mechanism *A'*. Comprising the mechanism which provides automatic control is lever 51 of switch 50 connected to arm 53 mounted on rock shaft 41 by link 54. Whenever the rock shaft is moved as a result of a can passing finger 44 without a top, and thus permitting continuous engagement of clutch members 43 and 40, the mercury tube, Fig. 1*X*, is swung over in an inversely tilted position in which the mercury makes contact between two terminals of an electric circuit for solenoid 27.

When the solenoid 27 is energized the vacuum-operated clutch-throwing mechanism, Fig. 1*Z*, actuates to stop the machine. Covered cans are discharged from the clinching machine and conveyed to the vacuumizing and seaming machine *B* by a chain conveyor 29, Fig. 1*Y*, and enter a chamber 30 from which they are carried into a vacuum chamber 31 where the ends are seamed.

In chamber 30 is an electric safety switch 33 contained in a circuit for the solenoid of the seaming machine which is associated with clutch mechanism 35. Switch 33 also controls a circuit for the solenoid 27 of the clutch throwing mechanism of the clinching unit. In case of mal-operation in the vacuumizing and seaming machine the circuits of both solenoids are closed thus stopping the entire machine.

The circuit for the seaming machine solenoid

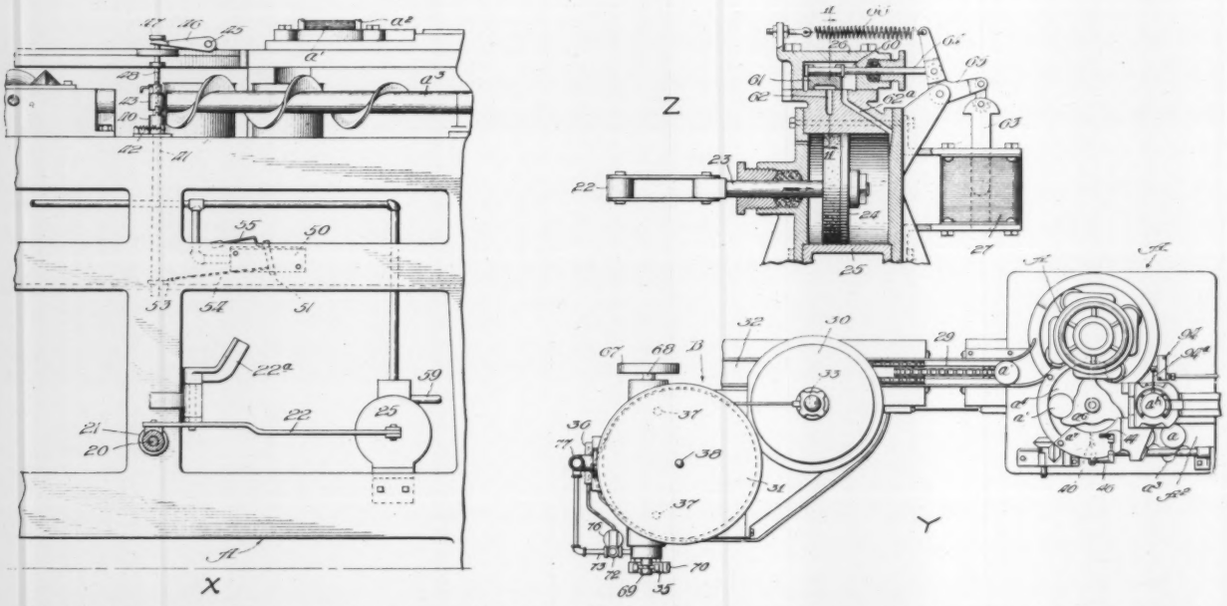
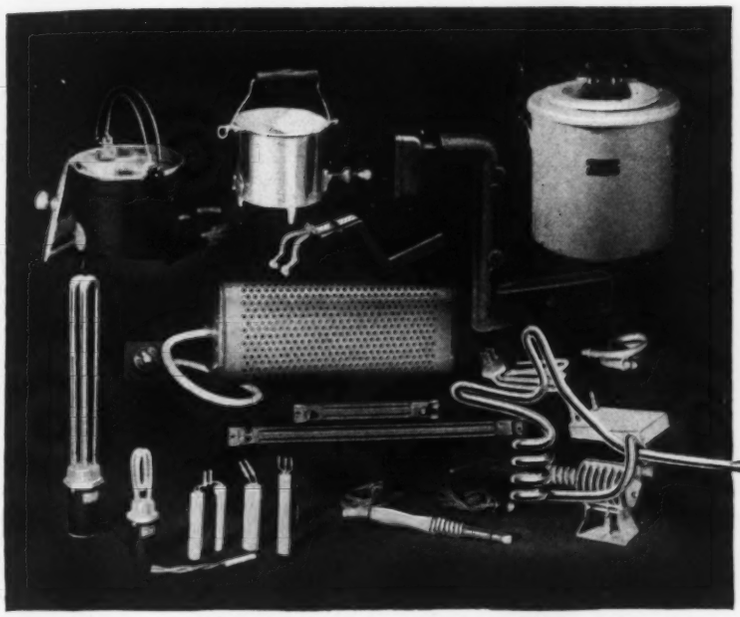
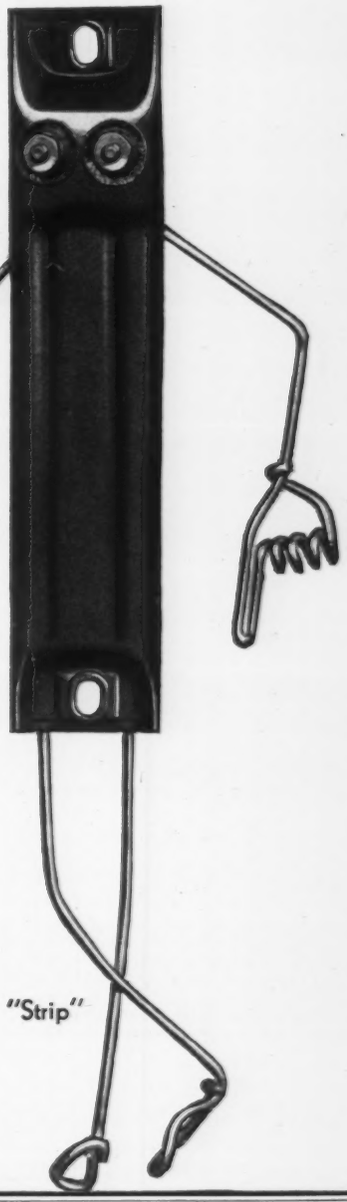


Fig. 1—Details of two associated can machines provided with an automatic control for stopping one or both units, depending on the nature of the mal-operation. Mercury switches and solenoids are employed





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GENERAL ELECTRIC

is also controlled by vacuum switch 36. In case the vacuum supply fails or is diminished, the mechanism of the vacuum switch operates to tilt another mercury tube and thus close the circuit for its solenoid, which being energized opens valve 72 and places the cylinder of the pneumatic clutch under the influence of vacuum to stop the machine.

Henry A. Fink, New York, and John E. Schmidt, Chicago, are the inventors of this automatic control mechanism. The patent which has been assigned to Continental Can Co. Inc., New York, is designated No. 1,848,827.

DESIGNED to atomize the fuel thoroughly, provide an adequate supply of air to support combustion while at the same time preventing excessive whirling and eddying, and to take care of any leakage of oil from the pump, an oil burner recently was granted United States patent No. 1,855,187. Fredrik W. Hvoslef is the inventor and Timken Silent Automatic Co., Detroit, the assignee.

Fan blades 39 which force air through the housing and into the nosing have an outside diameter slightly less than the inside diameter of the housing, and are adjacent to the rear ends of fins 12. The air from the fan normally would have a whirling motion which would interfere with combustion, but the radial fins prevent this condition of the air and cause it to flow straight through the housing 1 and nosing 2 shown in Fig. 2. Conical shield 30 in which the nozzle is located protects the flame from excessive air currents.

Fuel oil is supplied to the atomizing pump by means of a supply line including a magnetic

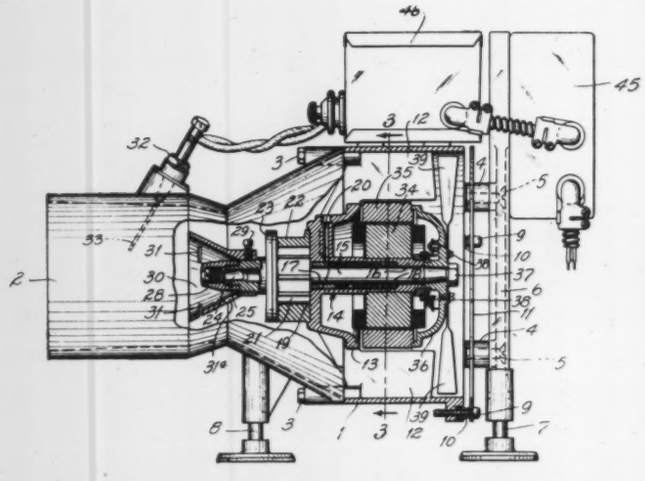

Fig. 2—Radial fins prevent whirling of air in this oil burner. Position of fan is shown

valve 40, Fig. 3, and a feed pipe 41 that terminates in an opening in the pump body 22. Air enters the pump through a separate passageway 42 located radially of annular member 13 and having a short cross port 43 opening into the interior of the pump body. This construction provides separation of the air and oil until they reach the interior of the pump.

Interior of bushing 17 is provided with an annular groove 44 near its forward end, the air passageway in 42 in the annular member ex-

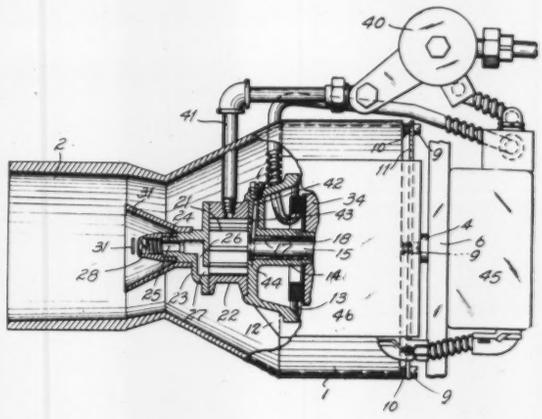

Fig. 3—Any oil that might leak out is conducted back into the pump by suction

tending beyond the cross port to communicate with groove 44. Consequently, if any oil should escape from the pump it would enter groove 44 and by the suction of the pump would pass back through the air passageway 42 and cross port 43 into the body of the pump.

TO Theodore M. Edison, son of the late Thomas A. Edison, has been granted a patent covering a vibration eliminator embodying an ingenious idea. While the arrangement is applicable to the elimination or reduction of all types of periodic vibrations whether of torsion or translation, the most satisfactory results have been obtained in cases where the vibrations have the character of simple harmonic motions.

The inventor sets forth in his patent that the idea is applicable not only to practically all types of mechanisms but also is capable of being expressed in many different mechanical forms. For purpose of illustration the invention is shown in Fig. 4 in connection with an electric motor which has an unbalanced armature shaft.

Vibration eliminating means applied to the motor comprise the four vibrators *Aa, Bb, Cc* and *Dd,* Fig. 4, arranged as shown about the armature shaft 2. Each of these members is made up of a weighted resilient rod having such dimensions that the natural period thereof is the same as the period of rotation of shaft 2 when the motor is operating at normal speed; in other words each vibrator is tuned to the frequency of the periodic force impressed on the motor by reason of the unbalanced condition of shaft 2.

Fig. 5 *B* and *C* show diagrammatically that when the motor is operating the force impressed thereon by the unbalanced shaft represented by *M,* always acts in a radial direction with refer-

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ence to the axis of rotation of the shaft, and that the line of action of this force while continually changing as the shaft rotates, always remains in a single plane which is normal to its axis of rotation.

The amount and line of action of this impressed force for the position of the mass M shown in Fig. 5 B, is represented by arrow F. Amounts and lines of action of such force for the full and dotted line positions M and M' of the mass as shown in Fig. 5C are represented

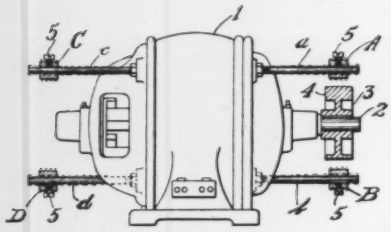

Fig. 4—Weighted resilient rods, four in number, are employed on an electric motor to dampen vibration set up by an unbalanced armature shaft

respectively by full and dotted arrows F^5 and F^6, and the locus of the amounts and lines of action of such force are represented by a circular plane figure indicated by the dotted circle G.

Referring again to Fig. 5B, as the mass M in the normal rotation of shaft 2′ reaches the position shown, the force F which it exerts on the shaft is theoretically exactly neutralized by forces represented by arrows F^1, F^2, F^3, F^4, respectively exerted by vibrators $A'a'$, $B'b'$, $C'c'$, $D'd'$. In case the mass M is located as shown in Fig. 5B, so that force F which it exerts is impressed on shaft 2′ at a point which is not

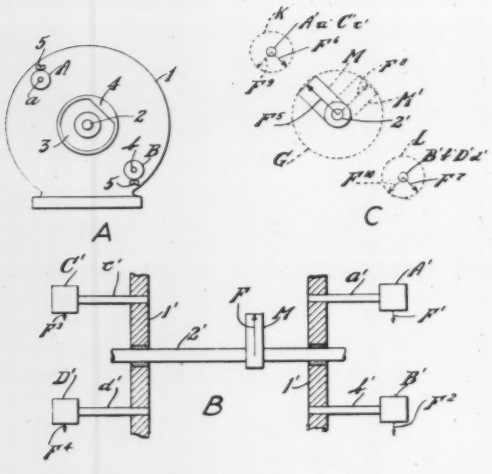

Fig. 5—Diagrammatic views illustrating how the vibration eliminator functions to neutralize forces

midway between the shaft bearings, the amplitudes of the vibrators $A'a'$, $B'b'$ will differ from those of vibrators $C'c'$ and $D'd'$, but automatically will so adjust themselves that the algebraic sum of the couples produced by these forces will be zero.

The patent, designated No. 1,855,570, has been assigned to Thomas A. Edison Inc., West Orange, N. J.

Review of Noteworthy Patents

Other patents pertaining to design are briefly described as follows:

FRICTION DRAFT GEAR—1,853,932. A friction shock absorbing mechanism comprising a friction shell having longitudinally arranged friction surfaces; shoes wedged into engagement with these friction surfaces by means of a central wedge member; and means for causing a spirally rotative frictional engagement of the shoes with the longitudinally arranged friction surfaces. Assigned to National Malleable and Steel Castings Co., Cleveland.

OILPROOF SPINDLE END—1,855,193. This patent covers an arrangement comprising a sleeve having a recess at one end, a spindle journaled without the sleeve, an antifriction bearing between the sleeve and the spindle and fitted with the recess. Packing in a channel formed in one of the races of the bearing forms an oil-tight seal adjacent the end of the sleeve. Assigned to Cincinnati-Bickford Tool Co., Cincinnati.

STOP MOTION MECHANISM—1,855,335. A resetting device for a stop motion of a knitting machine having the usual drive control and tripping shaft, and comprising a resetting element adapted to be geared to the trip shaft, an actuating element adapted to be connected to the control, and motion transmission means between the actuating and the resetting element, and including a one-way driving connection. Assigned to Phoenix Hosiery Co., Milwaukee.

Parabolic Versus Circular Arcs

(*Concluded from Page 29*)

respective axes, x_1-y_1 and x_2-y_2 to the x-y axes and the resulting formulas determine y at any point x along the two curves. The procedure is similar for the lengthened boom and the resulting formulas contain the same terms with changes of sign.

On the first half of the reverse curve in the shortened boom

$$y = m + x \tan \alpha + x^2/2p$$

Compare this with the formula as derived from the circle arc

$$Y = \pm \sqrt{R^2 - (x + R \sin \alpha)^2} + m + R \cos \alpha$$

and note that in the one case all factors in the formula are of the same order of magnitude as the result or smaller, whereas in the other it is necessary to solve in terms of the radius, R, of the arc which is many times larger than the results to be obtained.

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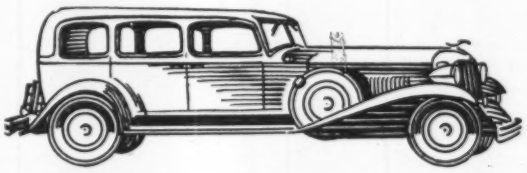

■ If your product must be made lighter without a sacrifice of strength, one solution is to replace ordinary steel with alloy steel parts. Before you write your specifications, however, supplement your knowledge of alloy steels with the vast fund of practical information that Electromet Service offers you without charge. As the pioneer producer of ferro-alloys and metals for steel-makers, Electromet has accumulated a body of data which, applied to your problems, will insure utmost economy in design and maximum satisfaction in performance. To realize maximum return on your investment in alloy steels, utilize Electromet Service. A request on your letterhead will bring you complete information.

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Topics of the Month

(*Concluded from Page* 43)

types was submitted by M. T. Schumb, Boston Gear Works, chairman of the library committee. These are expected to be of assistance to designers in ordering gears. Each sheet contains a sketch of a particular type with accommodation for all necessary specifications.

The importance of apprenticeship to industry and the part this method of training young men will play in the recovery of business was discussed by Harold S. Falk, Falk Corp. He firmly believes that the institution of apprenticeship has effected immunity against radical propaganda of all kinds in his organization.

* * *

New Materials Employed to Save Weight

THE trend toward the use of lighter metals in the design of equipment to save weight perhaps is no better illustrated than in two recent developments brought out to meet new transportation requirements. One is a fleet of hopper cars built of aluminum, and the other a truck trailer 50 feet long and weighing only 4180 pounds, constructed of magnesium alloys.

The aluminum hopper cars for railroad service, 70 in number, were built for the Alcoa Ore Co., a subsidiary of the Aluminum Co. of America. Similar cars of the same general dimensions from heavier materials weigh 60,100 pounds or 21,200 pounds more than the aluminized units. To obtain this 21,200 pound savings in dead weight, aluminum plates, shapes, and castings were used in fabrication of the new cars. The resistance of aluminum to corrosion also was an important factor in the selection of this type of material.

The truck trailer, one of the largest assemblies ever made from magnesium, embodies sheet and extruded sections made from Dowmetal F and E. Its weight of 4180 pounds compared to approximately 8700 pounds of a similar steel trailer is indicative of the possibilities of lighter materials in design to facilitate increased pay loads, cheaper motor power, higher traveling speeds, etc.

* * *

Less Nonferrous Metals Employed

REPORTS of 16 manufacturers which represent about 40 per cent of the industry show that nonferrous metals employed in the manufacture of washing machines in this country last year totaled 5,766,719 pounds compared with 10,813,644 pounds in 1930. Of the 1931 total, 4,274,470 pounds was aluminum against 9,534,-115 pounds of this material in the preceding year.

Decline in the use of aluminum is ascribable largely to substitution by enameled iron, the American Bureau of Metal Statistics reports. This drop in the use of nonferrous metals came in spite of the fact that in 1931 the number of units made by the 16 manufacturers totaled 261,246 as against 254,145 machines in 1930. The use of copper sheet, however, showed a rise of 438,895 pounds in 1931, indicating a large decrease in employment of other nonferrous materials.

* * *

Racer Powered by Three Airplane Engines

WEIGHING nearly 5500 pounds and powered by three airplane engines, a new French racing car designed by M. Stapp was given a recent tryout at Chatou near Paris. The auto is nearly 33 feet long and according to the inventor, has a speed range of 320 to 385 miles an hour.

The three 800-horsepower Jupiter engines, arranged so as to form a "motor turbine," have, according to Engineer Stapp run in bench tests 57 hours at 22,000 revolutions per minute. The car also carries a 60-horsepower engine to start the "motor turbine," and set the vehicle in motion. The body is cylindrical in shape and carries a large tailfin, the exhaust being carried off through a number of vents in the conical tail.

* * *

Eight Coffin Fellowships Are Awarded

EIGHT fellowships to graduates of American colleges or technical schools have been announced by the Charles A. Coffin Foundation, established by General Electric Co., to give recognition to various forms of achievement related to electrical and technical development. These fellowships will enable the men receiving them to pursue a year of research studies and investigations in electricity, physics or phyical chemistry.

* * *

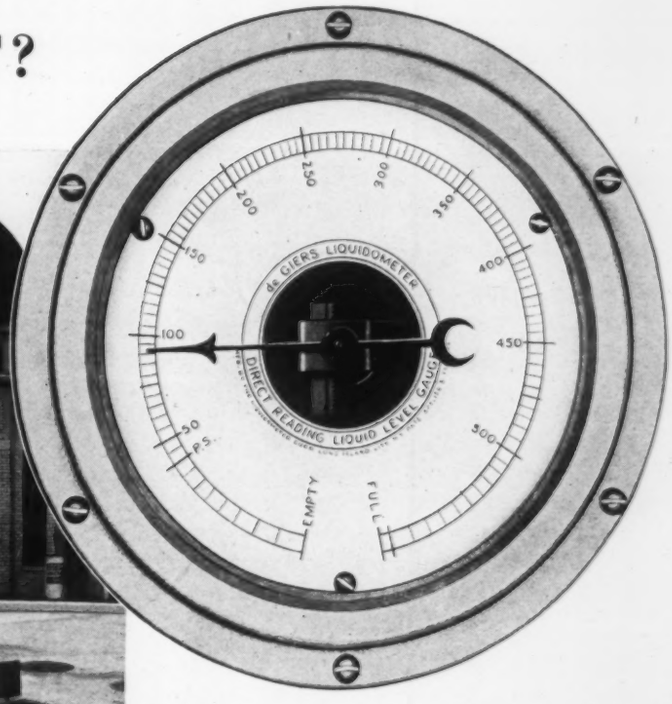
Plans Survey of Die Casting Industry

COMPLETION of arrangement for a survey of the die casting industry in this country by department of commerce has been announced by Director Feiker, bureau of foreign and domestic commerce. The American Die Casting institute requested the project as an aid to more effective economic planning and individual operation in this field.

Consisting of two phases, one part of the survey will be a general study of the industry and will be conducted by the questionnaire method. The other is to be a special case study of certain specific problems as found in the practice of six or eight specially selected plants.

EXPOSED *to dust and wet*

BUT WHAT OF IT?



HOT or COLD, WET or DRY

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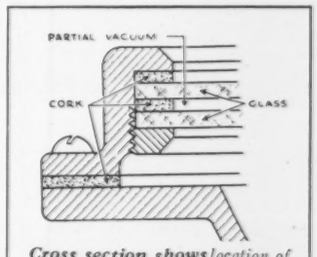
That's what the Liquidometer Corporation, of Long Island City, N. Y., was after—a material of *lasting* efficiency. That's what Armstrong, through its engineering service and product research, was able to deliver.

No other natural or synthetic material combines in equal degree the unusual properties of cork—resilience, compressibility, no progressive deterioration, low thermal conductivity, buoyancy, frictional efficiency, chemical inertness, uncommon resistance to the penetration of air, moisture, and oil.

More than this, Armstrong is able to control these properties of cork according to your individual needs. The right cork composition for any job that cork can do, will be furnished.

HOW ABOUT YOUR JOB? Our Industrial Sales Engineers will help you work out your problems of sealing, cushioning, sound deadening, insulation, and friction (both driving and braking). Armstrong's Cork can be shaped to your specifications and adapted to a wide range of service requirements. Outline your problem and send blueprints, if possible, to Armstrong Cork Company, 918 Arch Street, Lancaster, Pennsylvania.



***Cross section shows** location of cork gaskets between glasses, between glass and metal, and where housing is bolted.*

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NEW MATERIALS AND PARTS

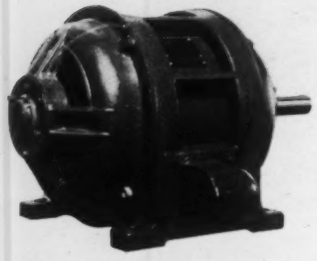
Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Screenless Motor Is Announced

DESIGNED to meet conditions encountered in various manufacturing processes connected with the textile industry, where the atmosphere is heavily laden with floating particles of lint, a new screenless open motor has been brought out by General Electric Co., Schenectady, N. Y. In designing the motor, shown herewith, no attempt has been made to prevent lint from entering it.

In this regard, the air passages have been so constructed that as soon as lint enters it is immediately blown out. This improvement has been made possible through the following features of construction: Smooth glossy windings to which lint will not adhere; no pockets or recesses in or about the windings; large, well-placed frame and shield openings which allow lint to pass freely in and out; dust and oiltight bearing housings which eliminate lint-catching spots of oil or grease on the motor.

With this construction, manufacturing and maintenance costs have been reduced, the use of screens and their attendant care is eliminated, and the necessity for totally enclosed motors, with their higher initial costs, in lint-laden atmospheres of textile mills is materially limited.



Air passages in motor are so constructed that as soon as lint enters it is blown out

Small Magnetic Clutch Has No Brushes

NO brushes, brush holders or collector rings are required on the extremely small multiple disk magnetic clutch recently designed by Magnetic Mfg. Co., Milwaukee. The clutch, shown herewith, measures only 4 ½ inches diameter and is one of the smallest that has been built. It requires 30 watts, direct current, for operation. Torque capacity is 600 inch pounds. The magnet is stationary and the unit is designed for use as a built-in machine drive.

One of the smallest magnetic clutches ever built has a torque capacity of 600 inch pounds

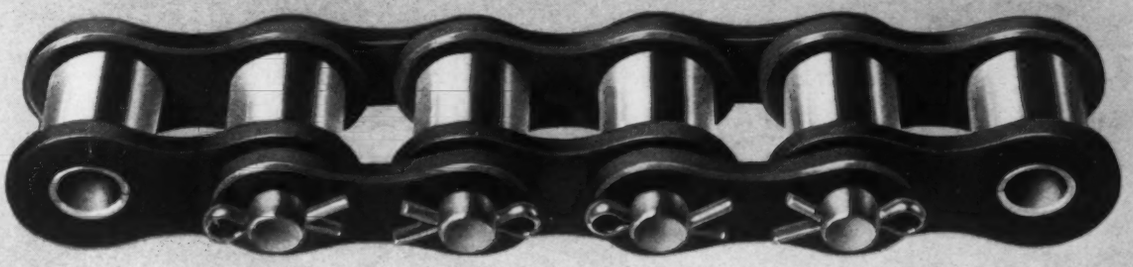
Flexible Unit Carries Caster Load

BY ELIMINATING the king bolt, and putting in its place a flexible unit, Divine Bros. Co., Utica, N. Y., with its TonWate caster has brought out a revolutionary design in truck caster units. This new part, shown herewith, is of simplified 2-piece design, constructed throughout of heat treated steel forgings, chrome nickel steel balls and roller bearings.

The flexible ball joint which replaces the rigid king pin is seated on the hardened cup of a self-locking safety set screw. The raceways are held together by the simple method of splitting them vertically instead of horizontally. By this balanced assembly, the load is distributed on center and annular balls, approximately two-thirds on the former and one-third on the latter. Each ball supports equal load and resists

CHAIN BELT COMPANY

REX ROLLER CHAIN



An Important New Source for Users of High Speed and Short Center Drives

Rex Roller Chain and Sprockets are offered in all standard sizes from ⅜ inch to 2½ inches. All chains and sprockets are built to the A. S. M. E., S. A. E., and A. G. M. A. standards.

Specially selected steels, accurately cut and machined, carefully case-hardened, are assembled by most modern machinery into a roller chain of outstanding qualities, high tensile strength and a high degree of finish and uniformity, handsome in appearance, and completely interchangeable with other standard makes. Rex Roller Chain is backed by a Chain Engineering Force, long skilled in the application of chain drives, with a complete line of malleable, steel and roller chain at their disposal.

Shipment from Stock

Immediate shipment of chains and sprockets, all standard sizes, can be made from stocks maintained in Eastern, Central, and Western United States.

If you are unacquainted with Rex Chains, or are interested in this important new line of Rex Roller Chains, check the coupon for data on the types that interest you.

CHAIN BELT COMPANY, 1804 West Bruce St., Milwaukee, Wisconsin. We are interested in the merchandise checked below.

Name..... Title..... Firm Name.....

Address..... City..... State.....

ROLLER CHAINS

☐ Rex Roller Chain ☐ Chabelco Steel Chain
☐ Malleable Roller Chain ☐ Unicast

COMBINATION CHAIN

☐ Rex Durobar ☐ Combination
☐ Ley Bushed ☐ Roof Top

☐ Sprocket
☐ Set Collars
☐ Take-ups
☐ Buckets

MALLEABLE CHAIN

☐ Griplock ☐ Riveted Mill
☐ Pintle ☐ Detachable

STEEL CHAINS

☐ Chabelco Roller Chain ☐ Cast Steel Drag
☐ Long Pitch Chabelco ☐ Drop Forged Chain

CONVEYING SYSTEMS

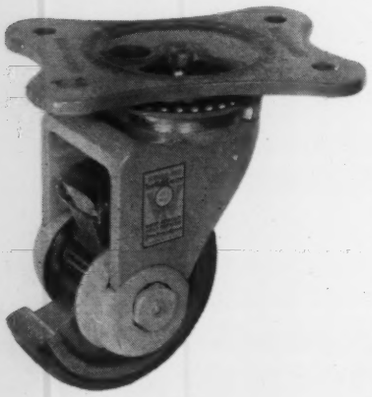
☐ Belt Idlers ☐ Belt Conveyors
☐ Elevators ☐ Chain Conveyors

REX ROLLER CHAIN

Established 1891—Branch Offices in 17 Cities

an equal part of thrust transmitted to them.

Main load bearings operate in a continuous reservoir of lubricant, sealed against dirt and water. The axle, which rides on automotive type roller bearings, also is protected by positive lubrication. Hub guards prevent the entrance of dirt, grit and water; also prevent strings and ravelings from winding around axle

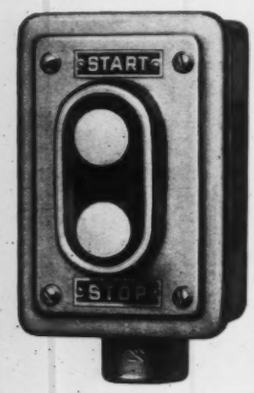


Flexible ball joint replaces rigid king bolt in new caster design, the center ball carrying about two-thirds of the load

and binding the wheel. The casters are supplied in a wide range of sizes, with steel and canvas cushion wheels, and also in a rigid type.

Control Station Is Water and Dust Tight

A MOMENTARY type control station of water and dust tight construction, known as class 9001, type BW-13, has been designed by the Industrial Controller division, Square D Co.,



Developed for applications where extreme moisture and dust conditions are encountered, momentary type control station is available in three designs

710 South Third street, Milwaukee. This control station, shown herewith, is developed for application in packing plants, creameries, flour mills, cement plants, foundries and similar locations where extreme moisture and dust conditions are encountered.

Class 9001 is available in three designs: Type BW-13 marked "start" and "stop"; type BW-13A marked "start" only; and type BW-13B marked "stop" only. The cast iron enclosure is gasketed to exclude moisture and dust.

Motors Permit Rapid Reversals

ALTERNATING current motors designed with torque characteristics to give rapid reversals are now being manufactured by Reliance Electric & Engineering Co., Cleveland. Low-inertia rotors are provided to keep reversing losses at a minimum. The motors, shown herewith, may be built to reverse forty times a minute, and are fully enclosed for protection against dirt, oil and moisture. Liberal radiating surfaces keep the temperature rise within reasonable limits.

These motors are unusually rugged through-

Fully enclosed motors of this type may be built to reverse forty times a minute

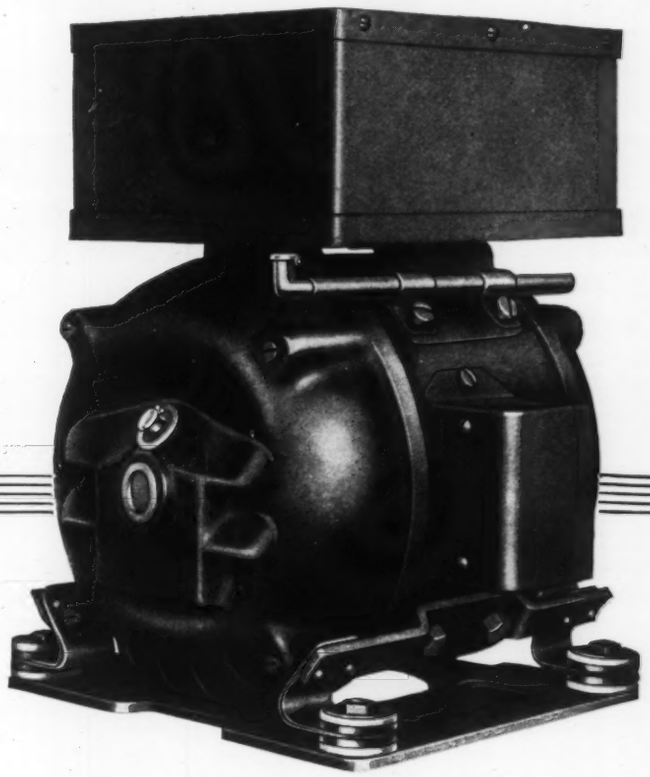
out. The shafts are extra heavy to give them ample strength to withstand the continual and quick reversals. Internal and external fans are made of cast duralumin, while the fans are designed liberally with wide, heavy hubs and large keyways.

Duo-Race Bearings Are Developed

INCREASED speeds and consequent larger production is made possible on plate cylinders and impression cylinders of newspaper printing presses and similar equipment by the use of new roller bearings developed by Bantam Ball Bearing Co., South Bend, Ind. In the manufacture of the bearings, shown herewith, one cage has twenty-three rollers and the other twenty-four rollers, giving a "hunting tooth" effect toward the elimination of synchronized vibration of cylinders at high speed. Each cage operates entirely independently of the other, eliminating bearing fight or twist.

The rollers and races have a lapped finish, the same as that of rollers in free wheeling units,

"THEY KEEP A-RUNNING"



1/6 Horse Power Century Type CP Capacitor Single Phase Motor with Cushion Mounting. Capacitor can be furnished as separate unit for wall mounting.

Interchangeable Mounting Dimensions

The following types of Century Fractional Horse Power Motors can be furnished for continuous-duty open-rating service, or totally-enclosed construction, with rigid or cushion mounting:

TYPE RS—*Repulsion Start Induction, Single Phase*
TYPE CP—*Capacitor, Single Phase*
TYPE SP—*Split Phase, Resistance and Reaction*
TYPE SC—*Three and Two Phase*
TYPE DM—*Direct Current*

Century MOTORS

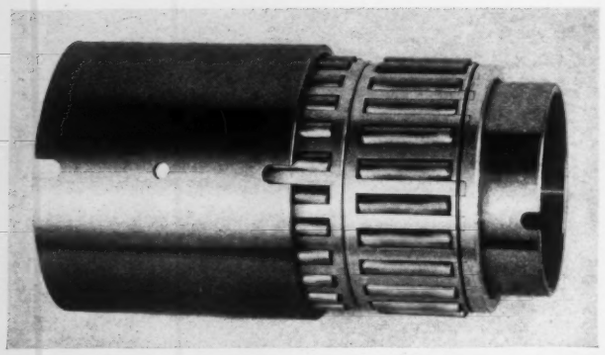
CENTURY ELECTRIC COMPANY, 1806 Pine St., St. Louis, Mo.
40 U. S. and Canadian Stock Points and More Than 75 Outside Thereof

SINGLE PHASE, THREE PHASE AND DIRECT CURRENT MOTORS · MOTOR GENERATOR SETS · ROTARY CONVERTERS · FANS AND VENTILATORS

CP1-36

FOR MORE THAN 28 YEARS AT ST. LOUIS

which greatly reduces the wear of the rollers and races. High carbon, high chrome special bearing steel, hardened and heat treated is used for rollers and races. This type of bearing can



One cage in this bearing has one more roller than the other, giving a "hunting tooth" effect

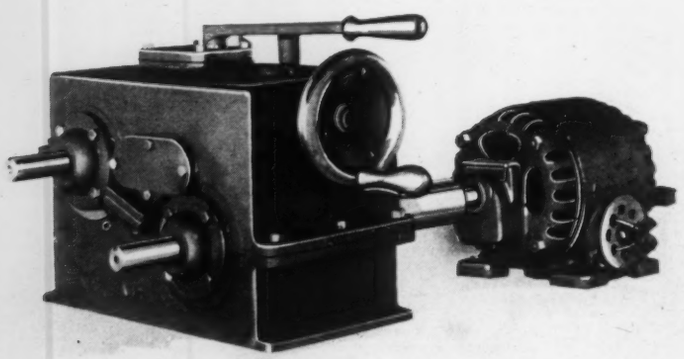
be made for limited space, rollers ½-inch diameter and races with ¼-inch wall thickness having been built.

Unit Provides Minute Speed Changes

SPEED range from 15 to 150 revolutions per minute, with the motor turning at a constant speed of 1750 revolutions per minute is available with a combined variable speed transmission and reduction unit brought out by Lenney Machine & Mfg. Co., Warren, O. Forward, neutral and reverse can be accomplished instantly by a shift lever while the motor is in motion. The reverse feature is optional to the user.

Speed of the unit, shown herewith, is controlled by a hand wheel conveniently located on the box, and may be adjusted to an infinite number of speeds. Operation is quiet, and is accomplished through special mechanical movements, no gears, screws, worms or belts being used.

The motor is coupled direct, without the use of reduction gears, making the entire assembly quite compact. The transmission is applicable to any drive where speed reducers or transmissions are used. Speed ratios other than the ones given in the foregoing can be furnished.

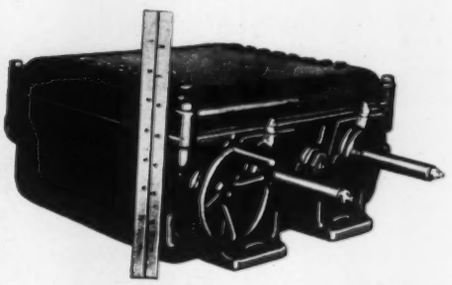


Recently introduced drive can have its speed varied to an infinite number of values

Transmission Parts Are Sealed

ALL working parts in the new size 106 variable speed transmission manufactured by Lewellen Mfg. Co., Columbus, Ind., are sealed against acids, abrasives, liquids, steam, etc. This smallest size manufactured by the company has the capacity of ¼ or 1/3 horsepower motor, with a maximum speed range of 6 to 1.

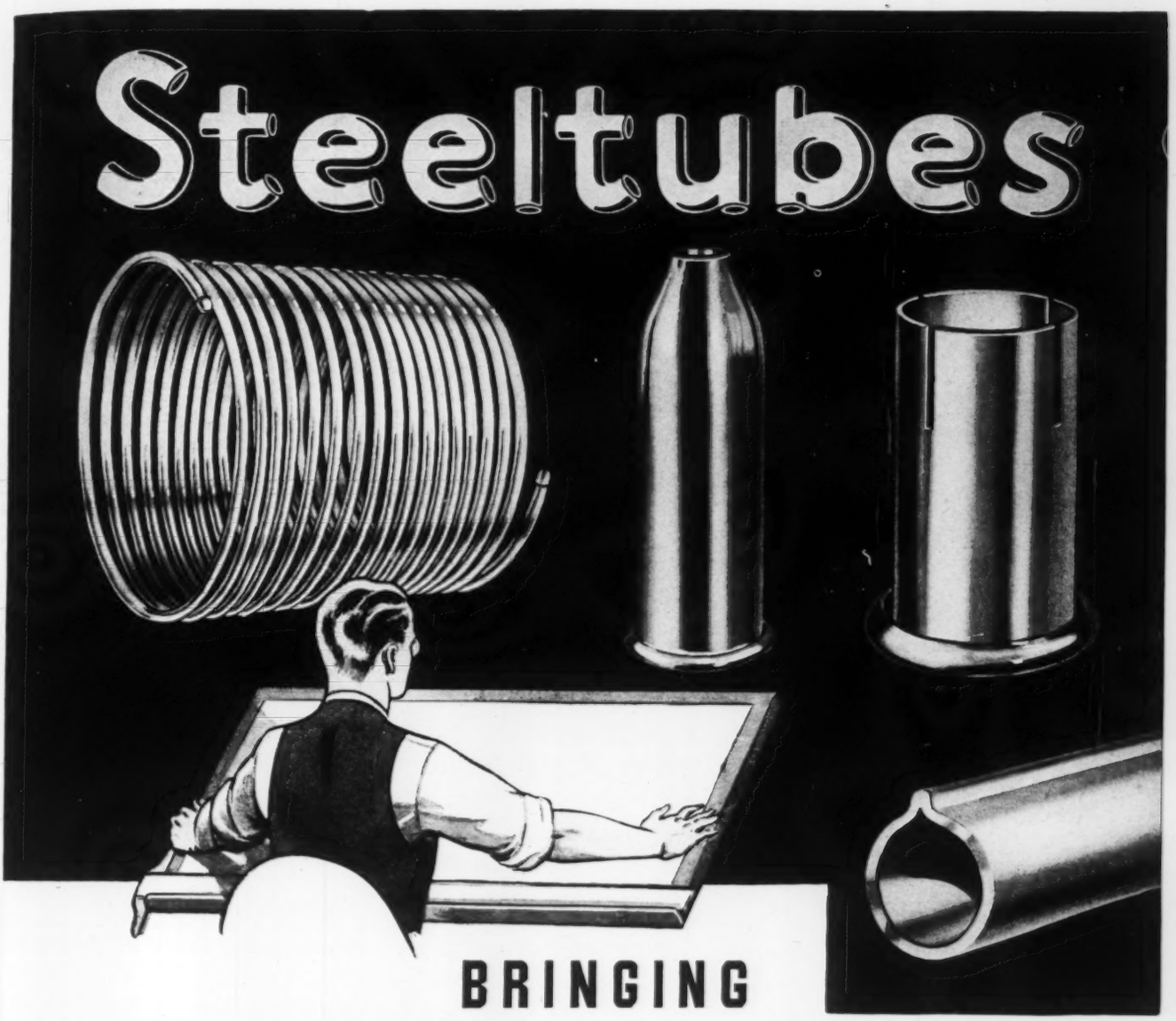
The unit, shown herewith, is especially adaptable for incorporation in small production machines requiring accurate variable speed control, as it is quite compact and may be mounted in any position. It may be lubricated completely or adjusted for belt tension without removing the cover or stopping operation. The series 100 transmissions are built in all sizes up to 15 horsepower.



Variable speed transmission is especially adaptable for incorporation in machines

Bi-metal Deflection Opens Breaker

CIRCUIT breakers which use a new method of arc extinction that enables elimination of all fuses in panelboards, distribution switchboards within the breakers' capacity and industrial applications where fused safety switches now are used are a recent development of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The trip unit of these circuit breakers includes both an inverse time bi-metal element and a magnetic instantaneous trip, within a totally enclosed and sealed case, which slide in and out of slots



BRINGING
NEW POSSIBILITIES IN DESIGN

Many manufacturers of metal parts are finding in Steeltubes opportunities for redesign with resultant greater strength, better finish, higher quality and increased sales appeal in the finished product. Hundreds of mechanical parts formerly made from other materials and by other methods are now being developed from this better tubing.

Steeltubes is a different kind of tube. It is electrically welded, with the weld 100% as strong as the wall. It is perfectly shaped, free from scale and uniform in wall thickness and size. It can be swaged, flattened, expanded, bent, beaded, punched or machined. And it can be had in sizes 3/16 to 5-inch O. D. up to .300 inch wall thickness in soft or carbon steel, Toncan Iron or ENDURO Stainless Steel, in a wide variety of shapes.

Look into the possibilities. Steeltubes, plus the experience of this organization in the application of tubular products in many industries, will show you economies you never dreamed existed. Detailed information furnished on request.

STEEL AND TUBES, INCORPORATED

World's Largest Producer of Electrically Welded Tubing

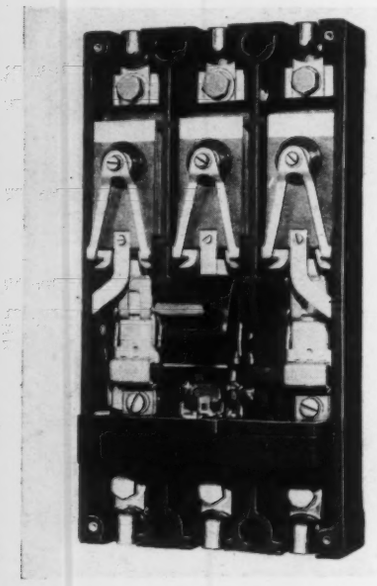
CLEVELAND » » « « OHIO

A UNIT OF REPUBLIC STEEL CORPORATION

which are molded into the sides of the breaker case.

The bi-metal changes its shape with temperature changes and is arranged so that the deflection, resulting from currents higher than normal, operates to open the breaker. An example of the time delay obtained is, on a given rating, when the bi-metal will hold in 22 minutes on 150 per cent of the breaker rating and 11 seconds on 600 per cent.

The principle of the instantaneous trip is similar to that used on air circuit breakers above 1200 amperes. A stationary magnet surrounds the main bus on three sides and when energized sufficiently attracts the moving magnet, which,



Bi-metal in circuit breaker varies its shape with temperature changes and deflections resulting from currents higher than normal open the breaker

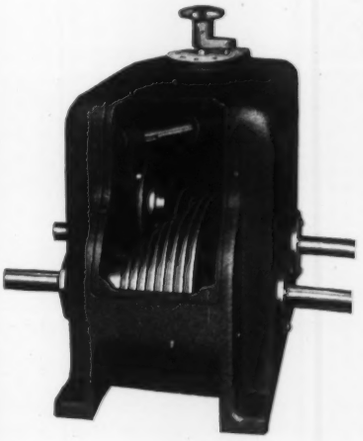
in turn, trips the breaker. The instantaneous trip can be calibrated so as to require an inrush of from 8 to 10 times the breaker rating before tripping occurs.

Composition Disk Transmits Power

DISKS of composition material that run as idlers between driving and driven cones transmit the load in the multi-speed transmission brought out by General Radial Drill Co., 1765 Elmore street, Cincinnati, O. A small diameter groove on one cone aligns with a large diameter groove on the other, the idler disk wedging in the grooves with a wedging action which varies in direct proportion to the load carried. The tendency of the disk is to push the centers apart, but as the cones are mounted an absolute distance apart, this tendency serves to increase the contact and provide a positive drive.

A simple movement of the knob shown on top of the unit gives a definite alignment for each of the speeds indicated on the plate. To change speed, the knob is lifted upward until dowel pin is clear of hole, thus lifting the idler disk out of contact. Then the knob is turned to the desired speed and the disk again brought into contact.

Transmission proper runs dry, the shaft ball

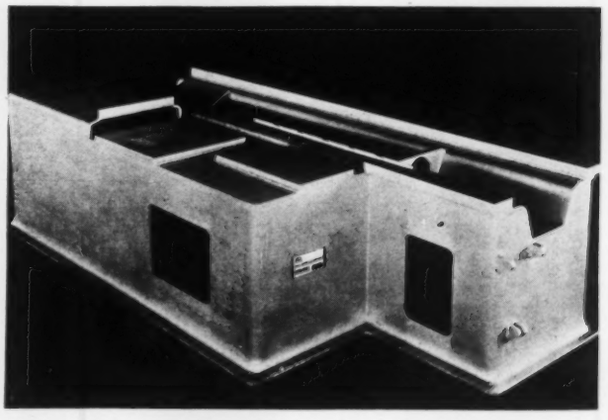


Wedging action of idler disk in variable speed transmission increases in direct proportion to the load carried

bearings being the only points which require lubrication. These can be lubricated from the outside. Eight speeds are available up to ratios of 9 to 1. Driving and driven cones are of steel and are mounted on steel shafts.

Weldings Afford New Design Styles

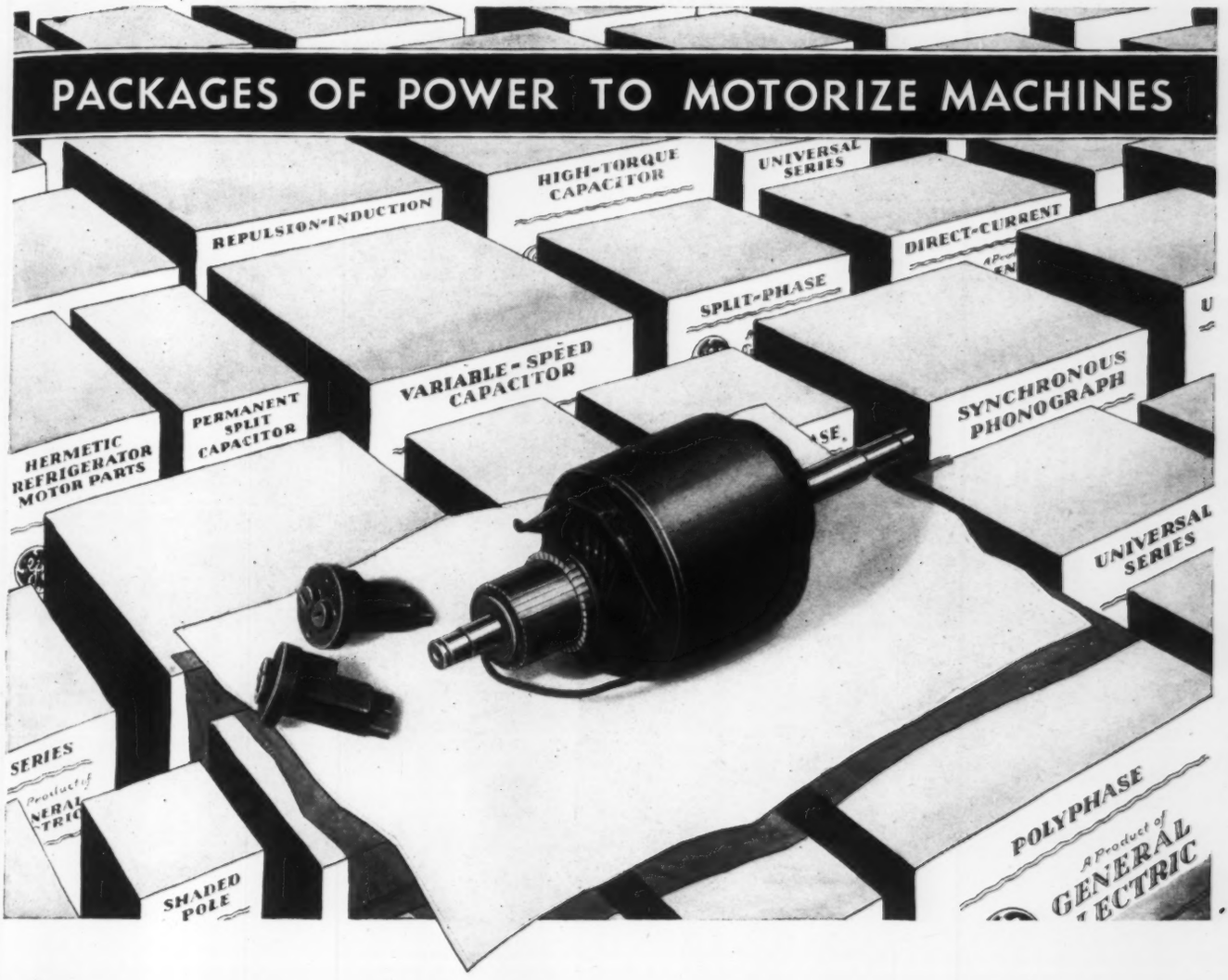
WELDINGS, or custom-built machine parts, bases, etc., now are being manufactured in a large number of forms in the weldery of Austin Co., Cleveland. A recent job, shown here-



Saw bed for multiple saw cutting of synthetic material built in job welding shop

with, is a saw bed for multiple saw cutting of synthetic material. The advent of the commercial jobbing weldery gives possibilities of new style and new strength to such design.

About eighty per cent of the companies that have been served by this jobbing shop are com-



EXAMPLE 3—FOR PORTABLE TOOLS. General Electric builds complete sets of small-diameter motor parts, here shown, which exemplify its ability to design dependable fractional-horsepower drives — not only for portable tools but for any need of modern motorized equipment.

General Electric has supplied the answer to every kind of motor problem for nearly thirty years. We are constantly coöperating with designers toward the perfect solution of their drive problems. *Exactly the right drive for the service* is our criterion. Why not take advantage of our specialized engineering facilities?

Confidence in a portable tool — confidence in any motorized device — is maintained by the performance of its drive; that's why a G-E motor is always a sound investment. Your nearest G-E office will gladly be of service.

210-170

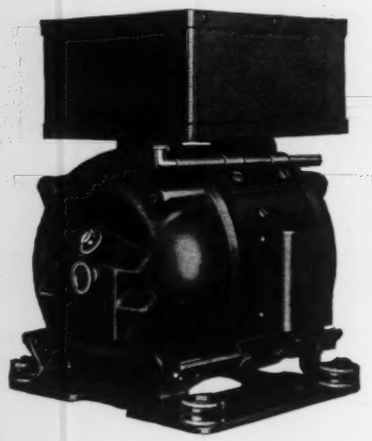
GENERAL ELECTRIC

panies that have never used welded parts before. One of the advantages of the shop lies in the fact that weldings, with attendant savings and advantages, can be adopted by many manufacturers even though they may be operating at extremely limited capacity.

Introduces Line of Capacitor Motors

SUPPLEMENTING its other lines of single phase motors, Century Electric company, St. Louis, recently has offered a line of capacitor motors in sizes from 1/6 to 10 horsepower, furnished for single or multispeed operation with normal torque, high torque or low torque characteristics, to meet the requirements of each application.

The small sizes, shown herewith, have the capacitor box mounted on the top of the motor,



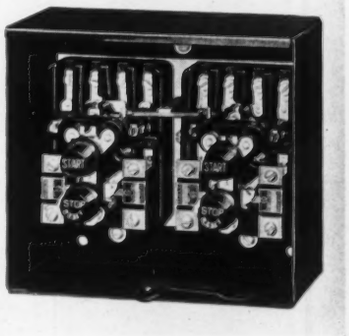
Single phase capacitor motors are furnished for single or multispeed operation with normal torque, high torque or low torque characteristics

although the boxes can be furnished for wall mounting as in the larger sizes. The integral sizes have a separate capacitor box which may be furnished for either wall or floor mounting. The operating characteristics cover a wide range of applications, from the direct-connected fan to the more exacting service required for oil burners and refrigerators.

Develops New Motor Starters

TWO-SPEED separate winding type and single speed reversing type starters for controlling across-the-line motors are recent additions to the line of alternating current manual starters manufactured by Industrial Controller division, Square D Co., Milwaukee. Both types have general application, but the two-speed type is especially suitable for heating and ventilating purposes and similar installations where remote control is not essential.

The maximum horsepowers of the three-pole starters are 5 horsepower at 220 volts and 7½ horsepower at 440-550 volts. Outstanding features of these starters, shown herewith, are: Front operation, thermal overload protection,



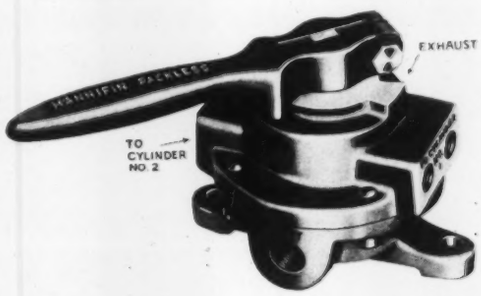
Additions to line of motor starters have two quick-break switch mechanisms interlocked to prevent simultaneous operation

operation of any relay to open main line and completely disconnect motor from line, two quick-break switch mechanisms interlocked to prevent simultaneous operation, and push button resetting without replacement of any parts after an overload. Maximum dimensions are: 13⅜ inches wide, 10⅞ inches high and 5½ inches deep.

Air Valves Are Electrically Operated

A DUPLEX air valve, designed for use on machines employing two air cylinders which operate in progressive sequence, has been put on the market by Hannifin Mfg. Co., Chicago. The new valve, shown herewith, has four independent outlet ports for control of two double acting cylinders. It is so designed that two cylinders can be operated in either direction and in any sequence desired.

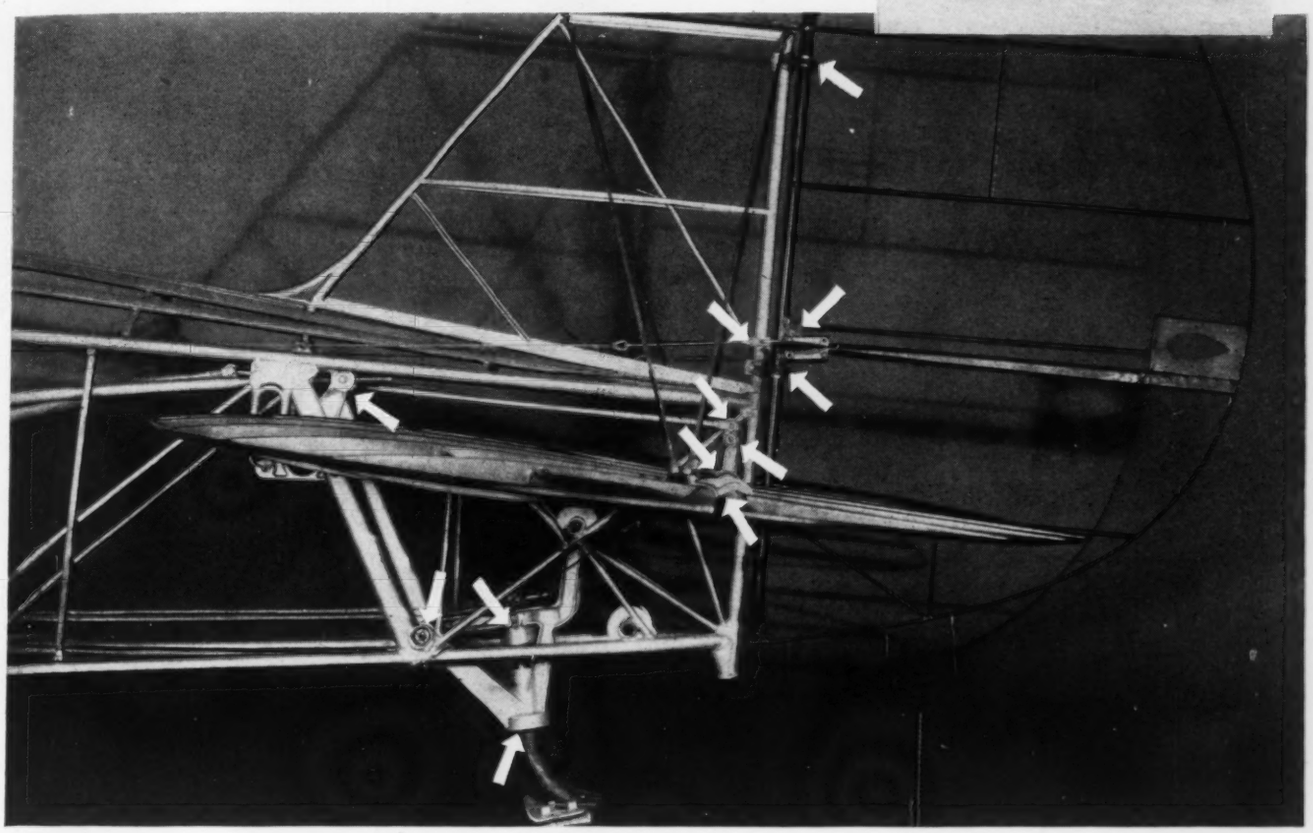
This valve embodies all of the features of the standard valves manufactured by the company,



Two cylinders may be operated in progressive sequence with this duplex air valve

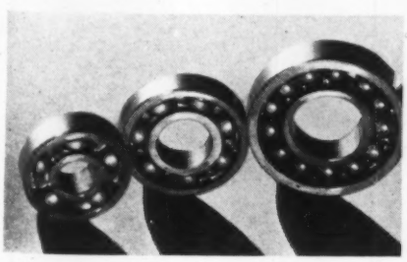
and is furnished in two sizes—Model D-37, with ⅜-inch I. P. connections, and Model D-75 with ¾-inch I. P. connections.

Plane Controls
...all Ball Bearings



100 Fafnirs on new Consolidated Trainer for smoother operation and lower maintenance

CONTROL system, landing gear, axle ends, brake controls, stabilizer adjustments and a majority of the other moving parts of the new Consolidated Trainer developed for the U. S. Army Air Corps function friction-free and service-free on 100 Fafnir Aircraft Bearings. This wide-spread use of ball bearings on a plane of this type demonstrates the fact that the advantages of smooth and dependable operation, elimination of costly servicing, and saving of weight and space made possible with Fafnirs, need not be confined to costly ships.



As with planes, so it is with other machines of every description Fafnir makes a line of ball bearings that is so complete as to assure the exact type and size for every application. Moreover, Fafnirs are made to extremely high standards of tough wear-resisting alloy steel. They virtually never wear.

Valuable information for engineers and designers is contained in the Fafnir Engineering Data Book. A copy should be in your files. But, inasmuch as no fast and inflexible rules can be laid down to assure the exact type of bearing and mounting for every application, we offer the cooperation of our engineering department without charge.

THE FAFNIR BEARING COMPANY
NEW BRITAIN, CONN.

Atlanta Chicago Cincinnati Cleveland
Dallas Detroit Los Angeles Milwaukee
Newark New York Philadelphia

FAFNIR

FAFNIR BALL BEARINGS

Business and Sales Briefs

CHARLES L. WOOD, vice president in charge of sales of Carnegie Steel Co., and prior to that general manager of sales for the company, has just been named vice president in charge of sales of the United States Steel Corp.

* * *

Geometric Stamping Co., Cleveland, has appointed Dudley H. Smith, 221 East Twentieth street, Chicago, its sales representative in Chicago.

* * *

Harry O. McCully, formerly president of the Erie Bolt & Nut Co., Erie, Pa., has been named general sales manager of the Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

* * *

Charles J. Gros, who has been indentified with the brass foundry business in Philadelphia for the past 20 years has become sales manager for Barry Bronze Bearing Co., Camden, N. J.

* * *

H. J. Ritter, assistant secretary, Norma-Hoffman Bearings Corp., Stamford, Conn., has also been made sales manager of the organization. To his new duties he brings the experience of years as sales engineer, and, later, as manager of the New York sales office for the corporation.

* * *

O. E. Laechelt, for the past five years with Bunting Brass & Bronze Co., Toledo, has joined the sales department of Detroit Seamless Steel Tubes Co., Detroit. In this connection, Mr. Laechelt will devote his efforts to the sale of Detrolined steel-backed bushings, a line recently developed by the company.

* * *

H. H. Snell, 1400 Walnut street, Philadelphia, is now Eastern sales representative for Universal Gear Corp., Indianapolis, maker of speed reducers, variables, clutches, etc. Mr. Snell's territory includes all Atlantic seaboard cities.

* * *

George Fiske has been appointed manager of the Kansas City office of General Electric Co. Mr. Fiske succeeds William Hand who has retired from active duty at his own request after 46 years of continuous service.

* * *

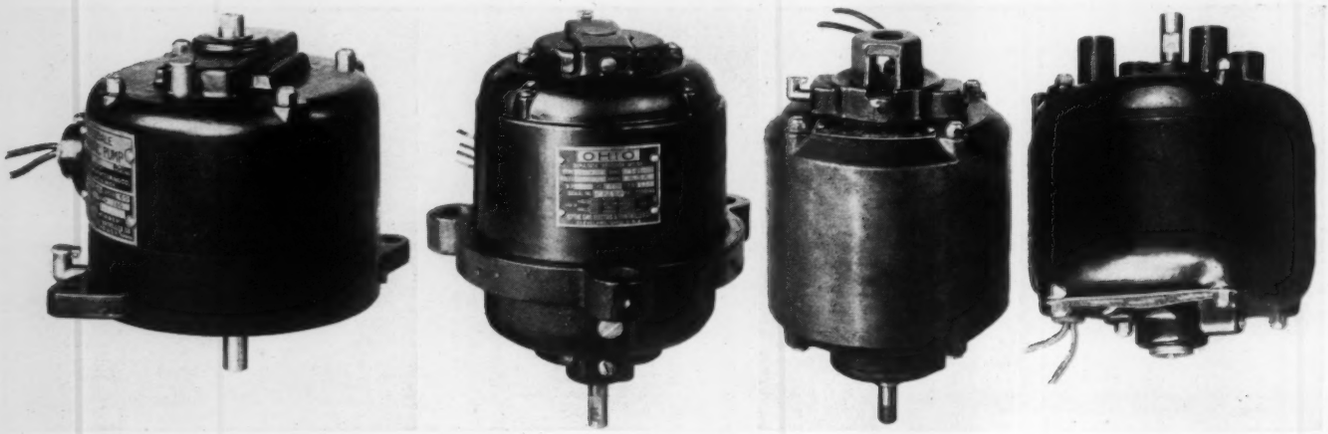
George L. Hurst, consulting mechanical engineer, 785 Market street, San Francisco, is now handling the sale of the Farrel-Sykes line of gears, speed reducers and gear drives manufactured by Farrel-Birmingham Co., Buffalo, N. Y.

* * *

Great Northern Tool & Supply Co., with stores and shops in Billings and Kevin, Mont., and Cody and Casper, Wyo., has been appointed distributor for products of Lincoln Electric Co. in Montana and Wyoming. This equipment includes welding supplies, welders and motors.

* * *

Farval Corp., 3277 East Eightieth street, Cleveland, recently acquired manufacturing and sales rights of the Farval centralized system of lubrication. A. J. Jennings, formerly vice president of Lubrication Devices Inc., is general sales manager of the Farval corporation. Distribution for the central industrial section of the country is being handled by Dingle-Clark Co., with offices in Cleveland, Cincinnati, Pittsburgh and Philadelphia.



YOU Design the Machine . . . . WE Design the Motor

Call our Engineering Department while your drawings are on the boards. Give us the power and the RPM. Indicate the position and the type of drive, and let us design a motor that will precisely fit the function and the structure of your unit.

Motors may be machined to fit into the framework of your design, or special frames will be built. Any type and any power from 1/50th to 1 H.P.

THE OHIO ELECTRIC MFG. CO. 5914 Maurice Avenue Cleveland, O.

OHIO *Reliable* MOTORS

WHO

TAKES CARE OF THE CARETAKER'S DAUGHTER

Who takes care of your equipment in your customers' hands while you're busy taking care of new designing jobs?

Your customers' workmen! Oh, yeh? They, after all, are only artisans receiving so much an hour and waiting for the weekly pay envelope. They have no more idea of the care and thought and study that went into designing that equipment than the night watchman.

If the machinery goes—fine. If she breaks down! Too bad. Must be a poor machine—bad design.

Are you beginning to get it now?

Unless you insist upon specifying the KIND of lubricants to be used on your equipment after it leaves your hands, you are hanging your neck out for plenty trouble and criticism.

May we show you how Alemite Specialized Lubricants for industry SAVE machinery from unnecessary breakdowns and repair bills? And after we show you will you, like hundreds of design engineers, INSIST that Alemite Lubricants be SPECIFIED to take care of your equipment in your customers' hands?

Alemite Corporation, (Div. of Stewart-Warner).
2644 N. Crawford Avenue, Chicago, Illinois

Gentlemen: I am interested in information regarding Alemite Systems and Lubricants from the designer's standpoint.

Name .....

Company .....

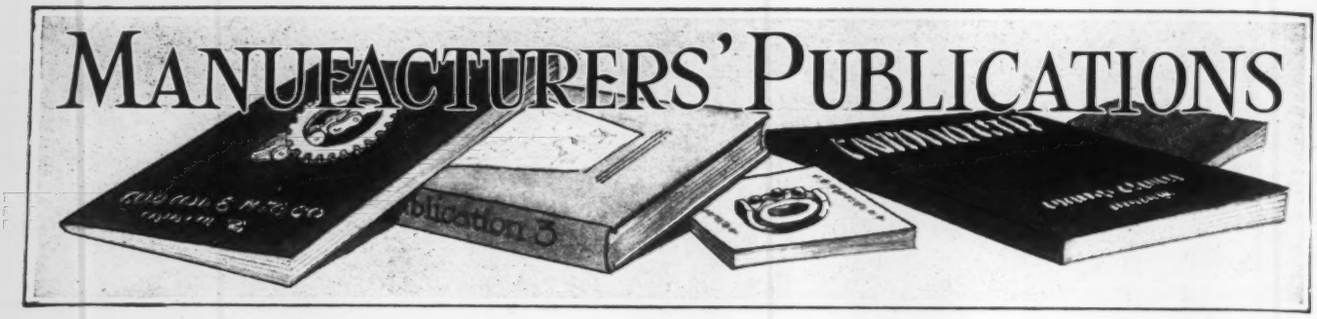
Address .....

City ..... State .....

596

PIONEERS IN SPECIALIZED LUBRICATION FOR INDUSTRY

MANUFACTURERS' PUBLICATIONS



Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

ALLOYS (NICKEL)—Steel castings made of nickel alloy for a large variety of uses and satisfying varied specifications are presented in data and application sheet 8-A of International Nickel Co. Inc., New York. The bulletin considers the applications, chemical composition, physical properties and production of the castings.

ALLOYS (STEEL)—Nitralloy, steels of special analyses for use in the nitriding process, are completely covered in a recent bulletin of Associated Alloys Steel Co., Cleveland. The bulletin discusses nitralloy and the nitriding process, analyses and physical properties of the alloy, operations prior to and after nitriding, properties of the nitrided case, and equipment for nitriding.

BEARINGS—Centrifugally cast bronze for propeller shaft sleeves, pump liners, bearings, roll covers and bushings are described in bulletin No. 131 of Shenango-Penn Mold Co., Dover, O. In these castings porosity is eliminated, density increased and greater homogeneity insured.

BEARINGS—Correct bearing design, materials and construction, applications of the bearings made over a period of years in a number of industries, and a description of the roller bearings made by the company are included in an attractive booklet of Timken Roller Bearing Co., Canton, O., entitled "34 Years of Engineering Development and Experience."

CAST PARTS—The effect of design on the making of steel castings is considered in an interesting pamphlet of Detroit Steel Casting Co., Detroit. This interesting publication presents points which should be considered by the designer, the effect of casting procedure on design and similar points.

CONTROLS (ELECTRICAL)—Monitor Controller Co., Baltimore, Md., has prepared an interesting folder on its system of starting direct current motors automatically. The device used to secure constant torque acceleration, called the Accelerator, works on the same principle as used in the chemist's balance, weighing electro-magnetic force.

CONTROLS (ELECTRICAL)—Low voltage circuit breakers which employ a new method of arc extinction that enables elimination of all fuses in panelboards, distribution switchboards within the breaker's capacity, and industrial applications where fused safety switches now are used are presented in two publications of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Circular 1939 contains a general description of the new breakers, breaker ratings, and their applications. Circular 1937 gives construction and application details of the 225-ampere breaker.

CONTROLS (ELECTRICAL)—Air circuit breakers of the open and enclosed type are described and illustrated in catalog No. 5 of Roller-Smith Co., New York. This catalog, which is offered as an aid in selecting the proper breaker, includes standard, industrial and enclosed types, 750 volts and less, direct and alternating current.

COUPLINGS—American Flexible Coupling Co., Erie, Pa., is distributing its latest bulletin, No. 102, which describes the line of couplings manufactured. This coupling, providing complete flexibility without the use of flexible materials, incorporates a floating center member free to slide across the face of either or both of two flanges on a line through the center.

DRIVES—Worthington Pump & Machinery Corp., Harrison, N. J., has issued an interesting folder on its multiple V-belt drive for power transmission. The folder includes information on the drives and examples of installations.

DRIVES—Multi-speed transmissions which transmit the load through idler disks of composition material that set up a wedging action in direct proportion to the load are described in a bulletin of General Radial Drill Co., Cincinnati, O. There are eight speed changes which may be had up to ratio of 9 to 1.

DRIVES—Hill Clutch Machine & Foundry Co., Cleveland, presents in catalog No. 29-A information on its power drive equipment including shafting, couplings, oil film bearings, water cooled and heavy duty oil film bearings, base plates, floor stands, wall boxes, hangers, agitator bearings and plain grease bearings.

DRIVES—High speed gear units suitable for increasing speed of driven unit as well as reducing speed are announced in bulletin No. 425 of Farrel-Birmingham Co. Inc., Buffalo, N. Y. The bulletin presents a complete description of the units, includes photographs of installations, and gives dimension data sheets and horsepower rating for both speed reducing and speed increasing units.

HEATING UNITS—Special heating strips are cast integrally with composite fins of aluminum alloy in the new electric heating unit evolved by American Foundry Equipment Co., Mishawaka, Ind., and described in pamphlet No. 31631. This method of construction increases the amount of heated surface and thus increases the radiated heat.

MATERIALS (COMPOSITION)—Spaulding Fibre Co. Inc., Tonawanda, N. Y., has prepared an interesting folder

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